# THE IRON TRADE REVIEW

Volume XLVI CLEVELAND, JANUARY 6, 1910 Number 1

## HEAVY SALES

### MADE TO USERS OF NON-BESSEMER ORES.

### Last Year Makes a New Record for Pig Iron Production—Good Business in Tin Plate and Sheets.

The year 1907 ended in gloom. When the last day of 1908 passed, there was a feeling of relief, because the twelve months had been full of suspense, but there was a distinctly confident expectation that 1909 would record much more satisfactory business conditions than the two previous years. This expectation has been fully justified, and, although a note of warning of the danger of overproduction has been occasionally sounded, the country has shown its wonderful ability to consume the immense production of blast furnaces and mills.

**Blast Furnace Production**

One year ago, satisfaction was being expressed because of the fact that the progress being made toward resumption of normal conditions was indicated by blast furnace statistics, which then showed that the production of coke and anthracite pig iron for the first half of the year was 6,789,463 tons, while for the second half the production was 8,885,123 tons, and the daily production in December, 1908, was 55,666 tons. The production continued to increase during the first half of 1909, for which period the output of blast furnaces was 10,820,672 tons, but the amazing increase came in the second half, which produced 14,516,330 tons, making the total for the year 25,337,002 tons, an increase of 37,270 tons over the previous record year, 1907. The daily production for December, 1909, was 86,539 tons. To the figures for coke and anthracite, about 400,000 tons may be added for charcoal pig iron.

**Ore Selling Rapidly**

Keen interest has been felt in the trade as to how the blast furnace operators would meet the announcement of the advance of 50 cents on non-Bessemer ores. It soon developed that while some consumers were disposed to complain, others were not, and nearly all, with the exception of those of the east, were ready to place their orders. Hence, buying has been very heavy during the past few days, and several million tons have been contracted for. Some independent interests have not announced their position in regard to the ore situation, but it is believed that they will conform to the recently announced prices.

**Very Few Cancellations**

Specifying against contracts expiring with the year were very heavy, and cancellations made on account of failure to specify were few. New business is not very heavy and contracting is being done in a very conservative way, conditions varying according to material, the character of order, and desirability of the business. Rail sales of the week amounted to about 25,000 tons, of which 20,000 were open-hearth for the Burlington. Negotiations involving considerable tonnage of rails are pending in the Pittsburg district. Severe weather conditions have interfered to a considerable extent with operations at many plants during the past week.

**Sheets and Tin Plate**

Tonnage of sheets and tin plate entered for rolling last month was extremely heavy, not having been equalled since the final month of 1906. Some sheet manufacturers have such large tonnages on their books that they are declining to take new business. In some cases, premiums of $2 per ton are being obetained by sheet mills for quick shipment. The outlook for wire products for the first half of the year is excelient, but at the present time the market is quiet.

**Conditions in Coke**

A number of furnaces have been inquiring for coke for spot shipment and have made some purchases, but the reduced production, due to the holidays, has reduced the supply of prompt coke. Foundrymen in some sections are placing additional orders for coke, as they find their requirements are greater than anticipated.

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# THE WEEK IN IRON CENTERS

## PITTSBURG.

### Mills Open the Year Well Supplied With Tonnage—Basic Sales.

Office of THE IRON TRADE REVIEW,
510 Park Building, Jan. 4.

The iron and steel mills are beginning the new year with an accumulation of tonnage in finished products upon their books awaiting delivery which practically insures their full operations throughout the first quarter. Buyers have not overlooked any opportunities to specify in full their contracts expiring Jan. 1, many of which were negotiated at advantageous price terms, and the cancellation of unordered tonnage has been comparatively light. The prospects for the renewal of heavy buying before the present business shall have been worked off are reported to be very promising.

For the first time in a long period, the total reported sales of basic pig iron in Pittsburg and valley territory in December were larger than in Bessemer for any single month. The reported sales, however, scarcely represented the full extent of the transfers of basic recently made in this territory, principally to merchant interests to apply upon contracts and to middlemen. The basic average for December was $17.004, valley, or $17.904, Pittsburg, compared with $17.31, valley, and $18.21, Pittsburg, in November. The lower price was due to the picking up by consumers and sellers of different lots in middlemen's hands, which were pressing the market. The Bessemer average for December was $19, valley, or $19.90, Pittsburg, the same as in November. Some new inquiry has come out for foundry, but the week as a whole has been quiet. A local steel company bought 3,000 tons of low-phosphorus iron for first half from eastern makers at about $23, Pittsburg. Prompt sales of small lots of low phosphorus iron were made in this territory this week at $23.80, Pittsburg.

Makers of steel bars have not yet figured up the full extent of the cancellations of unspecified tonnage on contracts expiring Jan. 1, but state that it will be very light. Owing to the larger tonnage of steel bars bought and to the extent of the low selling earlier in the year down to 1.10c, Pittsburg, the possible cancellations were more likely to be greater in this line than in any other finished material. Buyers, however, have seen that every technicality in their contracts has been observed in order that they might have the benefit of the tonnage which the mills were obligated to deliver to them at profitable prices. Many had specified in full by Dec. 1, their contracts to the end of the year with the knowledge that deliveries could not be made until sometime in the first quarter. The steel bar mills begin the new year with an accumulation of orders for rolling which means practically three months full operations. Some new business for second quarter is being taken at 1.50c, which is the general level of the market. Bar iron is fairly active at 1.70c to 1.75c, Pittsburg, specifications from the west being quite satisfactory. The hoop market continues to show improvement both in specifications and in new business.

#### Demand For Steel.

The semi-finished material situation continues to show the great demand for steel, particularly open-hearth, to supply the needs of the finishing mills. Some of the largest makers are not selling in the open market because of their own heavy requirements, and are having some trouble to arrange their operations to supply the tonnage of open-hearth material needed for particular plants. Buyers of open-hearth steel in this territory have been applying to outside makers for tonnage and some sales of this kind have been made. Because of the relatively light demand for rails upon eastern makers, the Bessemer billet situation is not as congested as that of open-hearth, as some of the Bessemer product that has usually gone to rail operations is now being diverted to the open market. Merchant buyers of steel in the Pittsburg district now have out considerable inquiry amounting to a fairly large tonnage. One consumer is asking for 4,000 tons for first half. A large steel company which recently bought a tonnage of small open-hearth billets closed at $30 Pittsburg. Some fancy prices have been paid for small open-hearth billets for prompt shipment. The sheet bar situation appears a trifle easier in that shipments on contracts are being made more promptly to consumers. Some sellers of sheet bars within the $1 Pittsburg freight limits have been covering their regular customers at $28.50 mill, but are asking $29 mill to other buyers and this price is about the general level of the market. There appears to be a little freer offering of bars.

Important negotiations for rails affecting the mills in this territory are still pending. The outlook for rail mill operations over the first quarter is a little better through more liberal specifications being received. Some makers who have been rolling billets on rail mills have ceased taking orders for such steel in the open market for forward shipment until they can take a better accounting of their own future requirements. The light rail demand is well sustained, the Carnegie Steel Co. having booked 3,500 tons the past week. The standard spike market is not very active, but considerable business is going in small spikes.

#### Important Contracts Placed.

A number of important structural steel contracts were placed in the final week of the year. Principal among these was that calling for 25,000 tons for the new municipal building at New York, which was awarded to the Pennsylvania Steel Co. The American Bridge Co. took 8,000 tons for the first units for the contemplated new construction of the American Sheet & Tin Plate Co. at Gary, which will consist of light plate and sheet mills. The Donovan Wire & Iron Works, Toledo, took 1,600 tons for the new buildings of the Owens-West Bottle Co. at Fairmount, W. Va.. The Riverside Bridge Co., Wheeling, was awarded 1,500 tons for the Second National Bank building at Akron, O. Consumers of plates and shapes in practically all cases specified in full their contracts expiring Jan. 1, and cancellations by makers of unordered tonnage at this date were very small. The plate and shape mills began the new year with sufficient undelivered tonnage upon their books to insure their full operations for a number of months to come. The general situation in the eastern market has recently shown some softness and this quotation has been shaded. Little late car buying is reported. The remaining 500 of the 2,000 steel ore cars of the Duluth, Missabe & Northern and the Duluth & Iron Range railroads have been divided between the Pressed Steel Car Co. and the Clark Car Co., Pittsburg, the former receiving 300 and the latter 200. As previously reported, 1,500 of these cars will be of the Summers type.

#### Sheets and Tin Plates.

In sheets and tin plate, the month of December as to tonnage entered for rolling has presented a notable record, which is rivaled only by the final month of 1906, when an unexpected heavy demand for sheets was in evidence. Some of the largest makers of sheets have their outputs so engaged by contracts and by

specifications entered far ahead that they are declining new business. This condition is giving rise to a state of the market where premiums reported at $2 a ton are being obtained by some mills on quick shipment material. Tin plate consumers are specifying very freely against their contracts and orders on mill books are accumulating heavily, which in some cases are extending shipments on new specifications beyond May. Because of the reduced prices on tin cans, a heavy demand from canners is in prospect, and the can manufacturers are now specifying freely for their bright plate. Shipments to the more remotely located salmon packers of the Pacific coast are now going forward, and the main movement will follow after Feb. 1. Reports are current of premiums being paid for prompt plate, but this probably applies to terne plate, the production of which has been curtailed through labor disturbances.

Leading makers of wire products who held year-end meetings of sales organizations in Pittsburg and New York the past week report that prospects for spring business for the first half are very promising. At the present time, the market is rather quiet, since it is too early for the beginning of the spring buying movement. There are some current reports that concessions in wire prices have recently been allowed in close competition, but the extent of any shading is not well established. Wire rods are firm at $33 and $34 Pittsburg. The new classification of wrought pipe adopted by iron and steel pipe makers is now in effect, and has not been attended by any special developments. The pipe market is also rather quiet, as it is understood jobbers have freely covered at past low prices. There has been, however, a very fair specifying movement for this time of year. Boiler tubes are holding up well, and the outlook is more promising.

### Coke Little Changed.

The coke market has shown little change in the week. Some furnaces which have not covered on extended contracts have been shopping about for spot coke, and have been picking up some bargains, but the falling off of production Christmas week amounting to about 75,000 tons has somewhat curtailed the offering of prompt coke. Production the past week was, however, about normal. There is some spread in prompt prices according to grade, an eastern furnace paying $2.75 ovens for 3,000 tons of high grade Connellsville furnace coke for immediate shipment. A sale of 3,000 tons a month of furnace coke for first half at $2.75 to consumers is also reported. No confirmation of the rumor that the H. C. Frick Coke Co. has been buying heavily in the prompt market can be obtained, and this is probably untrue. The foundry coke situation is easier both in prompt and contract material. Water shortages in the operating regions are still causing trouble, but the recent thaws may provide some improvement. The scrap market continues dull, but dealers are unwilling to make price concessions in the anticipation of renewed buying soon.

There are no changes to be noted in the regular schedule of Pittsburg prices on various iron and steel products and quotations are omitted this week. The quotations for the year will be found in connection with the annual review in this issue.

## CLEVELAND.

### Non-Bessemer Ores Being Sold at Recent Advance in Price.

Office of THE IRON TRADE REVIEW,
Browning Building, Jan. 4.

**Iron Ore.**—Following the announcement of the advance of 50 cents a ton on non-Bessemer as well as Bessemer ores, sales of non-Besemer ores have been made in large volume. As announced last week, all the Bessemer ores available were quickly disposed of. Some furnace men have expressed surprise that the advance on non-Bessemer ores was 50 cents instead of 35 or 40 cents, but with the exception of the furnace owners in eastern territory, few have hesitated long in making their purchases. There has been considerable difficulty experienced in satisfying some furnace operators, especially those making malleable and basic, as there is a scarcity of ore low enough in phosphorus to meet the demands for low phosphorus products, and there is an increasing tendency to specify lower phosphorus in basic pig iron than was formerly the custom. Some independent interests have not yet announced what their position will be in regard to the ore situation, but it is expected that they will conform to the recently announced prices.

On base ores with the guarantee of 55 per cent on old range and Mesabi Bessemer, and 51½ per cent on old range and Messabi non-Bessemer, we quote as follows: Old range Bessemer, $5; Mesabi Bessemer, $4.75; old range non-Bessemer, $4.20; Mesabi non-Bessemer, $4.

**Pig Iron.**—The market is dull, the only sales of any consequence announced being about 1,000 tons of basic for first half, at $17.50, valley, and 6,000 tons of basic for last half at $18, valley. Foundries are taking their iron on contract, and in many cases are asking for anticipation of shipments. The minimum quotation for No. 2 foundry and malleable is $17, valley. The new furnace of Corrigan, McKinney & Co. will not go into blast before Feb. 1, as some unexpected causes for delay have been encountered. The report that the erection of a second stack by the firm had been started is not true. We quote, delivered in Cleveland, as follows:

| | |
|---|---|
| No. 2 foundry | $17.90 to 18.00 |
| No. 2 Southern | 18.35 |
| Gray forge | 17.15 to 17.40 |
| Bessemer | 19.90 |
| Lake Superior charcoal | 19.50 to 20.00 |
| Jackson Co. 8 per cent silvery | 20.55 |

**Coke.**—Foundrymen are showing considerable interest and some contracts have been made. A number of foundries have ordered additional tonnage of spot coke, as their requirements have proved heavier than they anticipated. For prompt delivery, Connellsville furnace coke is quoted at $2.60 to $2.75, and for contract, $2.75 to $2.80. Foundry coke is quoted $3.10 to $3.25 for prompt, and $3.25 to $3.40 for first half.

**Finished Materials.**—Very few contracts expiring Jan. 1 were cancelled on account of specifications not being received, as in nearly all cases the full tonnages contracted were specified. The leading interest is now making contracts for bars at 1.50c for first quarter, but is not making requirement contracts for other materials, sales being made only to meet the needs of specific jobs. Some independent interests are contracting more freely on bars, plates and shapes, but all selling interests are acting conservatively and are discriminating carefully. We note a sale of 3,000 tons of plates at 1.60c for delivery before March 1. There is a fair demand for light rails and some inquiry for standard sections.

**Old Material.**—The market for old material in this district continues dull and dealers are not looking for a resumption of activity for a week or ten days at least. At present there is not enough activity to justify any changes in the prices quoted a week ago, which are allowed to stand as the nominal prices. We quote, gross tons, f. o. b. Cleveland, as follows:

| | |
|---|---|
| Old iron rails | $20.00 to 20.50 |
| Old steel rails (under 6 feet) | 17.00 to 17.50 |
| Old car wheels | 17.50 to 18.00 |
| Old steel boiler plate | 14.00 to 14.50 |
| Malleable iron (railroad) | 17.00 to 17.50 |
| Steel axles | 19.50 to 20.00 |
| Malleable iron (agricultural) | 15.00 to 15.50 |
| Heavy steel | 16.25 to 16.75 |
| Country mixed steel | 14.00 to 14.50 |

We quote, net tons, as follows:

| | |
|---|---|
| No. 1 R. R. wrought | $16.00 to 16.50 |
| No. 1 busheling | 14.00 to 14.25 |
| No. 1 machine cast | 15.00 to 15.50 |
| Axle turnings | 11.00 to 11.50 |
| Machine shop turnings | 10.50 to 11.00 |
| Grate bars | 12.50 to 13.00 |
| Pipes and flues | 12.00 to 12.50 |
| Tank iron | 11.50 to 12.00 |
| Sheet iron | 6.50 to 7.00 |
| Wrought drilling | 10.50 to 11.00 |
| Stove plate | 12.00 to 12.50 |
| Cast borings | 8.50 to 9.00 |

## CINCINNATI.

### Pig Iron Has Firmer Tone—Pipe Maker in the Market.

Office of THE IRON TRADE REVIEW,
First National Bank Budg., Jan. 4.

**Pig Iron.**—A firmer tone to the pig iron market in this center has developed under increased inquiry and a few scattering sales. The demand has not, however, been sufficiently large to affect prices materially, but the dull and weak feeling has been dispelled and producers are inclined to regard the situation somewhat more confidently. But few of the inquiries pending last week have been closed and this pending tonnage, with the additional scattered inquiry, has been the feature of strength in the market. An Ohio pipe manufacturer is inquiring for 11,000 tons for delivery over the entire year and has closed for a portion of this tonnage. A manufacturer in northern Ohio is inquiring for 2,000 tons of northern iron and there are scattered inquiries of from 500 to 1,000 tons of southern and northern iron pending. There are two malleable consumers in the market, one for 2,000 tons and the other without specified tonnage, but probably for a larger amount. Prices continue at $14, Birmingham, for southern iron, and some of the leading producers are accepting business through the first half of the year on this basis, while others are maintaining $14.50. Northern iron is quotable at $17, Ironton, for malleable or No. 2 foundry. High silicon iron has been advanced to the schedule of $20, furnace, for 8 per cent, which is the asking price for first half of 1910. While the market has assumed a stronger or steadier tone the buying and inquiry has not yet been sufficient to become convincing as to the stability of prices in some quarters. It may be suggested that the present buying is confined to actual needs, melters preferring to cover at this time, the market having had a decline of from 50 cents to $1 per ton, but the element of speculative buying at present prices does not appear to be indicated. There is some call for prices for third and fourth quarter delivery, but southern furnaces prefer third quarter business and prices for the last half of the year are not established.

We quote for prompt shipment and delivery for the first half of 1910, delivered Cincinnati, based on freight rates of $3.25 from Birmingham and $1.20 from Ironton, as follows:

| | |
|---|---|
| Southern foundry No. 1 | $17.75 to 18.25 |
| Southern foundry No. 2 | 17.25 to 17.75 |
| Southern foundry No. 3 | 16.75 to 17.25 |
| Southern foundry No. 4 | 16.75 to 17.00 |
| Southern No. 1 soft | 17.75 to 18.25 |
| Southern No. 2 soft | 17.25 to 17.75 |
| Southern gray forge | 16.50 to 16.75 |
| Northern No. 1 foundry | 18.70 |
| Northern No. 2 foundry | 18.20 |
| Northern No. 3 foundry | 17.70 |
| Jackson county 6 per cent silicon | 20.20 |
| Jackson county 8 per cent silicon | 21.20 |
| Jackson county 10 per cent silicon | 22.20 |

**Finished Material.**—The market is firm and some sales have been made here on a basis of 1.50c, Pittsburg, for steel bars. There is the same persistent call for deliveries on uncompleted contracts and mills are not seeking first half business, but rather taking it on conservatively.

**Coke.**—The general market is quiet, but the shortage in equipments and delays on the part of transportation companies are resulting in considerable effort on the part of sales agencies to locate and hurry forward cars in transit. The light production incident to the holidays and to some extent due to the wintry weather, has tended to increase the difficulty in keeping consumers' supplies up to requirements. Prices are without material change and in the leading coke producing districts are as follows:

| | Prompt shipment. | First half 1910. |
|---|---|---|
| Connellsville district: | | |
| Foundry coke | $3.10 to 3.35 | $3.35 to 3.50 |
| Furnace coke | 2.75 to 2.80 | 2.75 to 3.00 |
| Wise county district: | | |
| Foundry coke | 2.75 to 3.00 | 3.00 to 3.50 |
| Furnace coke | 2.10 to 2.25 | *Sliding scale basis. |
| Pocahontas district: | | |
| Foundry coke | 2.85 to 3.00 | 3.00 |
| Furnace coke | 2.50 to 2.75 | 2.75 |

***Sliding scale basis means $1.60 for coke based on $9, Birmingham, for pig iron, with an advance of 16⅔ per cent of the amount over $9 at which pig iron is quoted. This is the usual basis. Other forms of sliding contracts are also made.**

**Old Material.**—The demand continues light and the market rules quiet. There is a fair movement of scrap on old contracts, but there is very little doing in new business. Dealers are taking a rather hopeful view of the outlook and expect increased activity during January. There has been but little effort to interest buyers or melters recently and prices while largely nominal have been fairly well maintained. Dealers' prices here are about as follows:

| | |
|---|---|
| Old No. 1 R. R. wrought, net tons | $13.50 to 14.00 |
| No. 1 machinery, net tons | 13.50 to 14.00 |
| No. 1 busheling, net tons | 13.00 to 13.50 |
| Old iron rails, gross tons | 18.00 to 18.50 |
| Old steel rails (re-rolling), gross tons | 17.00 to 17.50 |
| Old short lengths, gross tons | 15.50 to 16.50 |
| Old iron axles, net tons | 19.00 to 19.50 |
| Heavy melting scrap, gross tons | 14.50 to 15.00 |
| Stove plate, net tons | 10.50 to 11.00 |
| Heavy turnings, net | 9.25 to 9.75 |
| Cast borings, net tons | 8.00 to 8.50 |
| Car wheels | 15.50 to 16.00 |
| Grate bars | 12.00 to 12.50 |

## PHILADELPHIA.

### Furnace and Mill Operations Curtailed by Severe Weather.

Jan. 4.

**Pig Iron.**—Furnace operations during the past week have been badly handicapped, with the result that the output was sharply curtailed. In some parts of eastern Pennsylvania the snowfall was fully 30 inches, with drifts of considerable depth, rendering anything approaching adequate shipping facilities out of the question until late in the week, and few furnaces escaped suspension, while several stacks were banked for a number of days. Inability to secure limestone was the cause of one interest banking several of its furnaces, but in some instances temporary delays were occasioned merely by the difficulty in handling materials already in the yards. Conditions are again normal, however, and shipments are going forward as usual. Selling during the week has been limited to gray forge and pipe irons, transactions including several blocks of from 1,000 to 3,000 tons, with some attractive inquiries for pipe-making iron still pending. There has also been some little business in foundry, on which prices appear to be a shade firmer, but none in low phosphorus or basic. In regard to the latter, there is some degree of expectation that prices may shade off in sympathy with the recent sharp decline in heavy melting steel, on the theory that at its lower level scrap will be used in larger proportions by open-hearth plants. Two factors make this improbable—the narrow range between production costs and the present selling price of basic iron, the output of which is practically disposed of over the first quarter; and the fact that, although the present market on steel scrap is about $17, delivered, the mills are still taking shipments on contracts at a much higher figure and will continue to do so for some time. One of the leading producers in the district reports that it closed the year literally without any iron on its banks. We quote, first quarter delivery at eastern Pennsylvania points, as follows:

| | |
|---|---|
| No. 1X foundry | $19.50 to 20.00 |
| No. 2X Foundry | 19.00 to 19.25 |

| | |
|---|---|
| No. 2 plain | 18.50 to 19.00 |
| Standard gray forge | 17.75 to 18.00 |
| Basic | 18.75 to 19.00 |
| Low Phosphorus | 22.75 to 23.25 |
| No. 2 Birmingham | 19.00 to 19.50 |
| No. 2X Virginia | 19.50 to 20.00 |
| No. 2 plain Virginia | 19.00 to 19.50 |

**Finished Materials.**—Eastern mills and independent plants in western Pennsylvania are starting the year with a price of 1.60c, Pittsburg, well established on structural shapes and plates, though bar business at 1.45c is still reported. The line was sharply drawn on contracts expiring with the year and no extensions were allowed. Interest centers in two local hotel propositions, the Fairmount and the Mauran apartments, both of which seem certain to go through and will require good tonnages. The 1,000 tons of steel beams for the Vine street pier will probably be supplied by the American Bridge Co. Billets continue scarce and in good demand at $30, eastern mill. Because of the snowfall, some mills have been unable to obtain fuel and their operations have been limited, while at several points shipments were suspended for several days. We quote, Philadelphia delivery: Structural shapes and plates, 1.70c to 1.80c; steel bars, 1.60c to 1.70c; refined bar iron, 1.70c to 1.75c; billets $30.60.

**Old Material.**—The week has been featured by a condition without precedent in the trade—because of embargoes, either actual or threatened, not an important consumer of heavy melting steel in this district has been in a position to accept shipments. One interest located near this city, which has been accepting desirable old material, got in about 4,000 tons of foreign scrap and is exerting every facility to handle it. With these conditions prevailing, the heavy snowfall came rather as a relief to the scrap trade and had no appreciable effect. Mills are not buying and the $17, delivered, price is largely nominal, though it is reported that dealers are picking up some lots pressing for an outlet at even lower figures. We quote, gross tons, delivery at eastern Pennsylvania consuming points, as follows:

| | |
|---|---|
| Old steel rails (rerolling) | $18.50 to 19.00 |
| No. 1 steel scrap | 17.00 to 17.50 |
| Old car wheels | 17.00 to 17.50 |
| Old iron car axles | 29.00 to 30.00 |
| Old steel car axles | 23.00 to 24.00 |
| No. 1 railroad wrought | 18.50 to 19.00 |
| Wrought pipe | 16.75 to 17.25 |
| Cast borings | 12.50 to 13.00 |
| Wrought turnings | 14.50 to 15.00 |
| Heavy cast scrap | 17.25 to 18.00 |
| Railroad malleable | 16.75 to 17.25 |
| Stove plate | 13.00 to 14.00 |

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The Illinois Steel Co. lighted these stacks in December: South No. 3 on the 9th; Joliet No. 2 on the 12th; Union No. 3 on the 1st.

## BUFFALO.

### Pig Iron Firm and Higher Prices Expected—Scrap is Dull.

Office of THE IRON TRADE REVIEW,
932 Ellicott Square, Jan. 4.

**Pig Iron.**—The firm tone felt in the market during the closing weeks of the past year is present at the beginning of 1910. Producers are confident and buyers are looking well after their needs and are feeling out the market in every possible way. The question of prices is important and in this respect the market is somewhat unsettled, but there is no tendency toward lower prices. Indications point toward an advance. The production here, the tonnage on hand, the inquiry and needs of the foundries, make it apparent that quotations are likely to advance within the next few weeks unless some unforeseen change occurs in the business situation. It is generally believed that there will soon be an advance of 50 cents a ton. The call for all the foundry grades is steady and malleable has become a more important factor. One interest, to meet this demand, turned one furnace from foundry iron to producing malleable. This feature apparently is not due so much to railroad requirements as to other interests. Railroads have not come into the market for as much malleable as had been expected. The outlook for business is excellent at this time. This applies not only to the furnaces but also to the foundry interests, most of which look for business betterments during the first half. We quote f. o. b. Buffalo, deliveries during first quarter, as follows:

| | |
|---|---|
| No. 1X foundry | $17.25 to 17.75 |
| No. 2X foundry | 16.75 to 17.25 |
| No. 2 plain | 16.75 to 17.00 |
| No. 3 foundry | 16.25 to 16.50 |
| Gray forge | 16.00 to 16.50 |
| Malleable Bessemer | 17.25 to 18.25 |
| Basic | 18.25 to 18.75 |
| Charcoal | 20.00 to 21.00 |

**Finished Products.**—The close of December shows that specifications on old contracts, which expired Jan. 1, came out very freely, but little has appeared with the opening of the new year. The general tone and outlook is satisfactory. No new business has appeared which has not been previously reported. Several contracts for structural are pending. These may be closed during the week. Inquiry for structural dominates the market now, the call for bars having fallen off. It is generally reported that deliveries on bars are three months behind, but on structural deliveries may be had under favorable conditions in 60 days.

**Old Material.**—The lull in this market continues, inquiries being few and scattering and sales mostly of small tonnage. Firms carrying heavy stocks, however, are not discouraged and ask prices which hold up the tone of the market. Within the next few weeks, it is thought, some substantial activity will be felt. Prices are a little depressed and quotations on several lines are changed. Heavy melting steel is 25 cents less, the ruling price now being $16.25 to $16.75. Car wheels can be bought for $1 less than a month ago, $18 to $18.50. Machine shop turnings are now quoted at $11.75 to $12.25. It will be seen also from this schedule that cast iron borings are shaded 25 cents. The same is true of stove plate. Boiler plate is offered at $14.50 to $15. We quote, gross tons, f. o. b. Buffalo, as follows:

| | |
|---|---|
| Heavy melting steel | $16.25 to 16.75 |
| No. 1 railroad wrought scrap | 18.25 to 18.75 |
| No. 1 railroad and machine cast scrap | 16.50 to 17.00 |
| Old steel axles | 21.00 to 21.50 |
| Iron axles | 26.00 to 26.50 |
| Car wheels | 18.00 to 18.50 |
| Railroad malleable scrap | 17.00 to 17.50 |
| Machine shop turnings | 11.75 to 12.25 |
| Cast iron borings | 9.25 to 9.75 |
| Low phosphorus steel scrap | 21.00 to 22.00 |
| Old iron rails | 20.00 to 21.00 |
| Tank iron | 14.00 to 14.50 |
| Sheet iron | 9.00 to 9.50 |
| Stove plate | 13.75 to 14.25 |
| Pipe and flues | 14.00 to 14.50 |
| Grate bars | 13.00 to 13.50 |
| Boiler plate | 14.50 to 15.00 |

## ST. LOUIS.

### Some Inquiries Out, But Little Active Business Reported.

Jan. 3.

**Pig Iron.**—Inquiries are out in the St. Louis territory for several hundred tons of No. 2 southern iron for shipment over the first half of the new year, and for 500 to 600 tons of 50 per cent ferro-silicon for shipment from January to December of 1910. With this exception, business in the pig iron industry is about as dull as it has ever been known on the first of the year. Inventories and stock taking seem to be the order of the day, and until this work is completed it is not expected that a buying movement will begin.

The actual price of southern iron seems to be a little hard to determine. Some agents insist that $14.50 is correct, while others say $14, and some as high as $15. A careful canvass of dealers, however, leads to the belief that $14.50 is about present price. Northern iron is offered at $17 to $17.50, Ironton. Prices for southern iron, delivered, to which the Birmingham freight of $3.75 has been added, follow:

| | |
|---|---|
| No. 1 foundry | $ 18.75 |
| No. 2 foundry | 18.25 |
| No. 3 foundry | 17.75 |
| No. 4 southern | 16.75 to 17.25 |

**Coke.**—Business in coke is just about as dull as it is in pig iron, and there is no apparent indication of a change until the holidays are well over. Connellsville 72-hour foundry coke for prompt shipment is offered at $3.15 to $3.25, and at $3.25 to $3.50 for future delivery. Connellsville 48-hour furnace coke and Virginia foundry and furnace grades are bringing about the same prices as last week, with very little demand for Connellsville furnace. The freight on coke to East St. Louis and St. Louis is $2.80, and $2.70 from the Virginia fields when shipment is destined beyond St. Louis. By-product coke is unchanged in price.

**Old Material.**—The scrap iron market is about at a standstill, no sales of any importance having been reported during the last week or today. Our prices follow:

| | |
|---|---|
| Old car wheels | $17.00 to 17.50 |
| Old iron rails | 19.00 to 20.00 |
| Rerolling rails (4 ft. and over) | 16.75 to 17.25 |
| Old steel rails (2 ft. and under) | 16.50 to 17.00 |
| Light section relayers, 45 lbs. and under, subject to inspection | 21.00 to 23.00 |
| Relaying rails, subject to inspection | 24.50 to 25.00 |
| Frogs, switches and guards | 15.50 to 16.00 |
| Heavy melting steel | 15.50 to 16.00 |
| Shoveling steel | 14.00 to 14.50 |

We quote, net tons, as follows:

| | |
|---|---|
| No. 1 R. R. wrought | $14.50 to 15.00 |
| No. 2 R. R. wrought | 13.50 to 14.00 |
| Arch bars and transoms | 17.50 to 18.00 |
| Knuckles, couplers and springs | 15.00 to 15.50 |
| Shafting | 17.00 to 17.50 |
| Iron car axles | 20.00 to 21.00 |
| Steel car axles | 20.00 to 21.00 |
| Locomotive tires | 18.00 to 18.50 |
| No. 1 country wrought | 12.25 to 12.75 |
| Pipes and flues | 11.75 to 12.00 |
| No. 1 cast, 150 lbs. and less | 14.00 to 14.50 |
| No. 1 busheling | 13.00 to 13.50 |
| No. 2 busheling | 9.75 to 10.25 |
| No. 1 boiler cut | 11.50 to 12.00 |
| Boiler purchings | 13.00 to 14.00 |
| Cast and mixed borings | 7.50 to 8.00 |
| Machine shop turnings | 10.75 to 11.25 |
| Railroad malleable | 13.25 to 13.75 |
| Agricultural malleable | 11.50 to 12.00 |
| Stove plate and light cast scrap | 11.50 to 12.50 |
| Angle bars, splices, etc. (iron) | 17.25 to 17.75 |
| Angle bars, steel | 15.50 to 16.00 |

## SEATTLE.

### Great Activity in Finished Material —Pig Iron Market Quiet.

Office of THE IRON TRADE REVIEW,
302 Pioneer Bldg., Dec. 31.

Conditions similar to those which have prevailed throughout the whole of the last quarter mark the close of the year on the north Pacific coast. Finished materials and all light products are moving at a whirlwind rate, galvanized sheets leading the market in activity. Manufacturing plants are well filled with orders and local rolling mills are running at the topmost gait. Jobbing foundries and machine shops are doing only a moderate business. A market remarkably favorable from a consumer's standpoint continues to prevail in nearly all lines. Attractive prices exist in castings and in boiler, tank plate and structural work. Generally speaking, local foundry, shop and fabricators' prices have changed but little since the spring of the year in spite of the advances in raw materials. It is conceded in all quarters that this condition cannot continue much longer and increased prices to the consumer are expected to characterize the first half of the new year.

**Pig Iron.**—The market continues quiet with prices generally from $2 to $3 higher than those quoted six months ago. Several ships, with cargoes practically all sold, are expected to arrive during January. The steamer M. S. Dollar arrived Dec. 29 with 1,000 tons of Chinese pig. Manufacturing foundries are busy while jobbing shops are doing very little. As low as $40 a net ton is freely quoted on building castings, while contracts for high grade machinery castings are made at figures ranging from $50 to $80 a net ton. There is a large volume of building work under consideration, which will considerably increase the January foundry melt. Building castings in Spokane are quoted at 2¾ cents per pound. The foundrymen are anxious for and expect better prices, but in the meantime, at present, an unusual consumer's opportunity exists. Low foundry prices, however, are having a seriously depressing influence on the local pig iron market. We continue to quote in gross tons, foreign iron ex ship Puget Sound or Columbia river; domestic, f. o. b. Pacific coast terminals:

| | |
|---|---|
| No. 1, English Jarrow, spot | $24.00 to 24.50 |
| No. 1, Chinese, Han Yang, spot | 23.00 to 23.50 |
| No. 1, English, Cleveland and Jarrow, to arrive Jan., limited quantity | 24.00 to 24.50 |
| Glengarnock, Scotch, to arrive June-July | 24.50 to 25.00 |
| No. 1 English, Jarrow, to arrive June-July | 24.00 |
| Southern No. 2, domestic | 24.50 to 25.00 |

**Merchant Iron.**—Local mills rerolling common iron bars are doing an excellent business. The trade is very active, but freight traffic congestion is interfering with deliveries and is seriously handicapping jobbers in their efforts to keep all sizes in stock. A number of sizes of bars and light structural shapes are out of stock locally. Both iron and steel bars have advanced 10 cents per 100 pounds recently. Further advances in steel bars are anticipated. We quote base prices per 100 pounds, f. o. b. Seattle, as follows: Common iron bars, $2.30; soft steel bars, $2.50; machinery steel, $2.85; Norway iron, $3.75; angles, channels, zees and tees under 3 inches, $2.80.

**Coke.**—Decreased foundry consumption and improved freight conditions have combined to prevent any danger of a coke shortage for the present. Buying is light. The new washing plant of the Wilkeson Coal & Coke Co. will be in operation early in the year and a considerable improvement in the quality of this coke is expected to result. Prices are stationary. We quote net tons as follows, f. o. b. Seattle: Wilkeson foundry coke, $7.20; German Syndicate coke, to arrive May-June, $10 to $11.50.

**Sheets.**—An unusually heavy tonnage is moving and the recent advances have failed to check the demand. Stocks are maintained with difficulty and a number of jobbers are out of stock in many sizes. Galvanized sheets are particularly active, and specifications for delivery extending throughout the first half are pouring in. We quote as follows, f. o. b. Seattle:

Blue annealed sheets, No. 12, 3.30c; No. 13, 3.35c; No. 16, 3.45c; Nos. 22 to 24, 3.70c; No. 28, 4.05c. Galvanized sheets, Nos. 12 to 14, 4c; No. 16, 4.10c; Nos. 18 to 20, 4.40c; Nos. 22 to 24, 4.55c; No. 26, 4.75c; No. 28, 5.25c; No. 30, 5.85c.

**Old Material.**—Rerolling steel is in better demand. Foundry scrap is moving slowly. Prices are irregular with a slight downward tendency. We continue to quote net tons, f. o. b. Seattle, as follows:

| | |
|---|---|
| Foundry scrap, No. 1 grade | $18.00 to 19.50 |
| Foundry scrap, No. 2 grade | 16.00 to 16.50 |
| Old car wheels | 16.50 to 17.00 |
| Railroad wrought | 10.00 to 11.00 |
| Miscellaneous steel scrap | 5.00 to 8.00 |

## BIRMINGHAM, ALA.

### Sales of Pig Iron Confined to Car Lots at $14 for No. 2, at Furnace.

Jan. 3.

Market conditions during the past week have been quiet, due mainly to the holidays. However, several car lots were disposed of for prompt shipment on the basis of $14 per ton at the furnace. It is pretty generally conceded that this price is prevalent for prompt and first quarter business. Two of the larger interests report themselves out of the market, while others want $14.50 per ton for second quarter and first half business. The general feeling is that before the month of January shall have closed, interesting developments will have materialized. With the existence of such conditions comes added strength; and already sellers have dispelled to a great extent their recent anxiety. Southern charcoal iron re-

mains firm at $22 to $22.50 per ton at the furnace.

**Cast Iron Pipe.**—There has been considerable firmness manifested in the water pipe market the past week, and several large contracts have been let—different manufacturers in the district coming in for attractive tonnages. Business in the middle west has been exceptionally good. The city of Huntsville, Ala., is in the market for a good tonnage of 12-inch to 24-inch pipe. Following prices are quoted, per net ton, f. o. b. cars here: Four-inch, $25; 6-inch, 8-inch and 10-inch, $23; 12-inch and over, average $22, with a dollar a ton extra for gas pipe. Fittings, $60 per ton.

**Old Material.**—The old material market has undergone no change the week just closed, and has a strong tendency to keep in direct sympathy with the pig iron situation. Dealers are holding on, hoping for a substantial upward move in the pig iron market, which will stimulate their trade. Following prices, per gross tons, f. o. b. cars here, are quotable:

| | |
|---|---|
| Old iron axles | $20.00 to 20.50 |
| Old iron rails | 15.75 to 16.25 |
| Old steel axles | 17.75 to 18.25 |
| No. 1 R. R. wrought | 14.00 to 14.50 |
| No. 2 R. R. wrought | 12.00 to 12.50 |
| Old steel rails | 12.50 to 13.00 |
| Dealers' mixed wrought | 11.00 to 11.50 |
| No. 1 machinery | 12.50 to 13.00 |
| No. 1 steel | 13.00 to 13.50 |
| Old standard car wheels | 13.75 to 14.25 |
| Light castings, stove plate | 9.75 to 10.25 |
| Cast borings | 6.00 to 6.25 |

## BRITISH IRON MARKET.

### Pig Iron is Gathering Strength as Well as Finished Material.

Office of THE IRON TRADE REVIEW, Prince's Chambers, Corporation St., Birmingham, Eng., Dec. 24.

The upward movement in pig iron is gathering strength, and further substantial advances have taken place during the past few days. Yesterday, Cleveland pig iron was again reported firmer, business being done at 51s 1d ($12.50) cash, and three months 52s 2d ($12.76). The present stocks are 381,537 tons. Further inroads continue to be made upon maker's yards and hematite in particular is steadily improving. The general improvement has very materially affected the Midland markets, with the result that consumers have shown considerable haste in placing their contracts, and heavy bookings have been made. In some cases, consumers have had to pay 1s to 2s per ton upon recent figures, and there are numerous offers for the second quarter of the year. However, sellers refuse to entertain these in view of the strength of the market and the dearness of coke. The improvement will prevent one or two stoppages of furnaces that were planned, and will shorten the idle period of others. Welsh hematite pig iron is 1s dearer at 67s 6d ($16.52) to 68s 6d ($16.76), and Cumberland hematite has changed hands at 63s 9d ($15.60) for three months. The pig iron outlook is much better than it has been for a long time.

**Finished Iron.**—The Birmingham market on Thursday showed extraordinary buoyancy for a holiday gathering and finished and semi-finished departments showed greater animation than for a long time past. The most noteworthy change was an advance of 5s per ton in billets of all sorts, which makes the best kinds £5 per ton, and the commoner qualities £4 15s. Some very heavy contracts have been booked, and the market has been strengthened by the prospect of much smaller shipments from the continent and especially from Germany during next year. Both the South Staffordshire basic mills and the Welsh mills are full of work. In the Welsh district there are general advances and tin plates have been further advanced as the result of the jump in the price of tin. Rails are firmer at £5 7s 6d for heavy sections.

In the Birmingham district, most of the galvanized sheet mills are full of work with plenty of inquiries. Some of the mills will recommence on the day following Bank holiday. In spite of keen competition in prices, selling figures are quite half a crown dearer than they were a short time ago. Even bars are selling somewhat better, and makers can now realize the standard figure of £6. The only really dull department now is that of wrought iron tubes, for which the home demand is rather poor and competition both from America and the continent is very keen in tthe open markets.

From Swansea the tin plate shipments for the week total 88,760 boxes, reducing the Harbour Trust stocks to 104,460 boxes, compared with 174,400 a year ago. The tin plate trade generally is experiencing something like a boom.

In Sheffield the improvement proceeds very slowly and there is still a good deal of unemployment. There is, however, no slackening in orders for high-speed steel, especially for America and the continent. Railway contracts are barely up to the average and there are great complaints that the railways show an increasing disposition to negotiate with foreign steel makers. The firms who undertake heavy forgings for ship builders are very fairly off for work.

## CHICAGO.

### Sales of Steel Rails—Mills are Very Busy.

(Owing to the severe weather, a part of the Chicago report was not received up to press time. A review of the year in the Chicago district will be found elsewhere in this issue.)

**Billets.**—The situation in billets is more serious than ever, and there is a veritable famine in this form of steel, even more pronounced than the condition existing for weeks, which was bad enough. It may still be said that prices are nominal, to a very large extent.

**Merchant Bars.**—The first week in the new year opens with the market in a waiting mood, and with the expectation pretty well fixed in the minds of all that the strong feeling which has been dominant so long will prevail for some time to come, and that there is no reason to fear any relapse during the present year. Prices show no change of any sort. The New York Central is said to be in the market for 1,000 gondolas and the same number of box cars. There also is an unconfirmed report that the Northwestern road is in the market for 1,000 freight cars.

We quote, for Chicago delivery, as follows, with prevailing extras:

Bar iron, 1.60c to 1.65c; hard steel bars, re-rolled, 1.60c to 1.65c; soft steel bars and bands and small shapes, 1.68c to 1.78c base; hoops, 1.78c to 1.88c; planished or smooth finished tire steel, 1.88c to 1.93c; iron finish, up to 1½ x ½ inch, 1.83c base, tire card; iron finish, 1½ x ½ inch and larger, 1.68c, base, bar card; channel for solid rubber tires, ¾ to 1 inch, 2.18c, flat, and 1⅛ inches and larger, 2.08c, flat; smooth finished machinery steel, 1 inch and larger, 2.43c; flat sleigh shoe, 1.73c; toe calk steel, 2.23c; spring steel, 2.28c; crucible spring steel, 2.78c; tool steel, 7c to 9c, with higher prices for special grades. Quotations on shafting are 55 per cent off the list for carload lots, and 50 per cent off for less than carload lots, carload freight allowed to points in base territory.

On iron and steel bars from local stocks, we quote, as follows: Bar iron, 2c to 2.10c, base; soft steel bars, 1.90c to 2c per 100 pounds base; soft steel hoops, 2.40c to 2.50c, full extras.

**Plates.**—Mills in this territory still are compelled to turn away proffered business, which they are unable to accept because of the already crowded condition of their order books. Business has been coming in, for a

long time, at a rate in excess of shipments, and of course this could not go on indefinitely.

We quote, Chicago delivery, as follows: Tank plates, ¼ inch thick, 6¼ to 100 inches, 1.78c to 1.88c. For extras see Pittsburg report.

Store quotations are without change as follows: Tank steel, ¼ inch and heavier up to 72 inches wide, 2c to 2.10c; from 72 inches to 96 inches wide, 2.10c to 2.20c; 3/16 inch up to and including 60 inches wide, 2.10c to 2.20c; 72 inches, 2.35c to 2.45c; No. 8 up to 60 inches wide, 2.15c to 2.25c. Flange and head quality, 25c extra.

**Sheets.**—The sheet business is showing a little of the holiday quietness, but this is not a matter of concern with the trade, as orders in hand are sufficient to run the mills for at least two months. No change in quotations has been made since last report.

For mill prices see Pittsburg report. Freight to Chicago, 18 cents.

We quote store prices at Chicago as follows: No. 10, 2.25c to 2.35c; No. 12, 2.30c to 2.40c; No. 14, 2.35c to 2.45c; No. 16, 2.45c to 2.55c; Nos. 18-20, 2.80c to 2.90c; Nos. 22-24, 2.85c to 2.95c; No. 26, 2.90c to 3c; No. 27, 2.95c to 3.05c; No. 28, 3c to 3.10c; No. 30, 3.30c, galvanized sheets, Nos. 10 and 16, 3.20c to 3.30c; Nos. 18 and 20, 3.35c to 3.45c; Nos. 22 to 24, 3.50c to 3.60c; No. 26, 3.50c to 3.80c; No. 27, 3.90c to 4c; No. 28, 4.10c to 4.20c; No. 30, 4.50c to 4.60c.

**Rails and Track Supplies.**—Sales of heavy rails for the past week by the local interest amounted to 25,000 tons, of which 20,000 tons were open-hearth sold to the Burlington system. It is understood that the sale included also a very fair amount of track fastenings. An inquiry from the Alton and some other roads for 20,000 tons of rails is among the present week's report. About three-fourths of the rails sold to western roads, up to the present time, for this year's delivery, have been 90-pound, and it is said that a number of the railroads in the west are taking up the 80-pound and 85-pound rails on their main lines, or will take them up, and lay the heavier rails.

See Pittsburg report for prices on standard sections.

On light rails, Chicago delivery, we quote as follows: Light rails, 40 and 45-pound, $26.30, and 35-pound, $26.75; 16, 20 and 25-pound, $27; 12-pound, $28. In lots of 250 to 500 tons a reduction of 60c a ton from these prices is made; lots of 500 tons and up carry a reduction of $1 a ton. Track supplies, f. o. b. Joliet, angle bars, 1.50c to 1.60c; railroad spikes, 1.80c to 1.90c; smaller size spikes, 1.85c to 1.90c, base; track bolts with square nuts, 2.35c to 2.55c, base; with hexagon nuts, 2.50c to 2.70c.

**Cast Iron Pipe.**—There has been an almost complete absence of business in cast iron pipe, during the holiday week. No lettings are reported, and the new inquiries for this year's work have not as yet appeared. We quote as follows: 4-inch water pipe, $28.50; 6 to 16 inches, $27.50; larger sizes, $26.50; gas pipe, $1 a ton higher.

# METAL MARKETS.

## ST. LOUIS.

Jan. 3.

**Lead and Zinc.**—Prices for lead and zinc ore and their products in the Missouri-Kansas-Oklahoma district are as follows: Zinc blende, $46 to $49 a ton for 60 per cent grades; calamine, $27 to $28, 40 per cent basis; lead, $58 a ton, 80 per cent basis; St. Louis spelter steady at $6.12½; St. Louis pig lead, firm at $4.65.

Prices are greatly ahead of what they were the first week in 1909, and still further ahead of the first week's offerings in 1908. A comparison gives tthe following results:

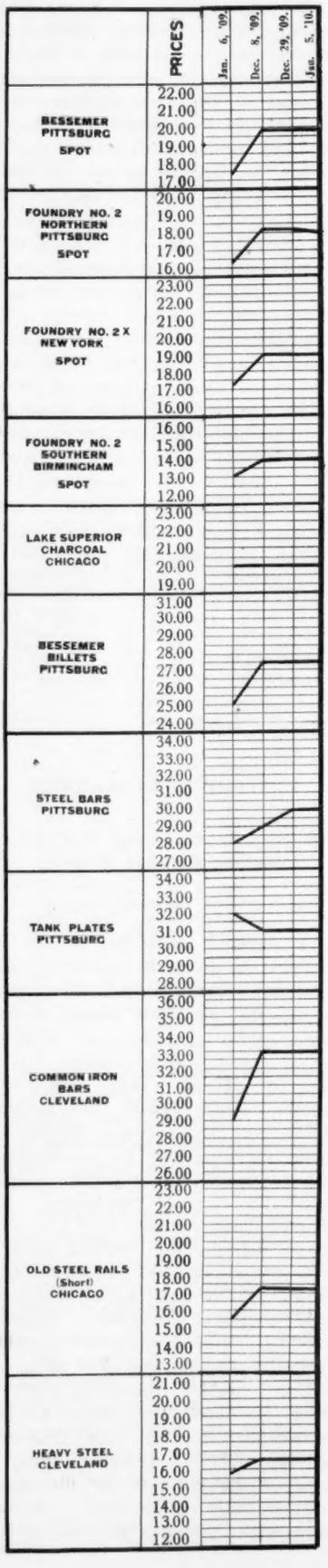
| | 1908. | 1909. |
|---|---|---|
| Zinc blende | $34 | $41 |
| Lead ore | 45 | 50 |
| Calamine | 13 | 19 |

Pig lead at St. Louis is much firmer than it was at the beginning of 1909. Quotations at the opening of the week were $4.15. Spelter was quoted at $5.15.

The outlook for 1910 is extremely encouraging. This prediction is based on the vast amount of development work in the very few mines that have been exhausted. The tonnage of lead and zinc ores for 1909 was greater than any preceding year excepting the banner year of 1907, but the valuation was lower than for 1907. The laying off of many workmen because of the holidays last week, and the extreme cold weather, resulted in smaller sales than for the week previous. Quite a number of plants also are temporarily out of commission while installing new boilers, etc., and a result of the new ruling of the gas company preventing the use of gas for fuel. Zinc blende sold as high as $52 a ton for 63 per cent grades, and calamine brought as high as $32 a ton for choice lots.

The Standard Screw Co., New York City, has declared the regular semi-annual dividend of 3 per cent on common and preferred stocks, payable Jan. 1.

## PRICE CHART.



## OHIO PIPE MAKER

### Places an Order for a Round Tonnage of Pig Iron.

Cincinnati, Jan. 5. (By wire.)

A northern Ohio pipe maker closed for 10,000 to 15,000 tons analysis iron, both northern and southern. A local melter has bought 1,800 tons of southern iron. An Indiana malleable melter closed for from 2,000 to 3,000 tons of malleable and a Cleveland, O., foundry bought 500 tons of southern iron. A number of smaller tonnages have been sold. All sales are close at schedule prices.

## SHOWING THEIR LIGHTING METHODS TO FOUNDRYMEN.

Different methods of plant lighting were exhibited and discussed before the monthly meeting of the Pittsburg Foundrymen's Association held at the Carnegie Technical Schools Monday evening, Jan. 3. Papers upon general industrial illumination with particular reference to foundries were presented by Allison J. Thompson, secretary of the Excello Arc Lamp Co., New York, and F. R. Fortune, Pittsburg district sales manager of the Cooper-Hewitt Electric Co. Mr. Thompson extolled the merits of the flaming arc lamp, while Mr. Fortune presented the advantages of the mercury-vapor lamp. Harry V. Allen, representing the General Electric Co., also spoke upon the flaming arc lamp of his company. Following the presentation of the papers and the discussion which was held in the auditorium of the technical schools, the meeting adjourned to the foundry of the institution, where a practical demonstration of lighting by the Excello and General Electric lamps was given, under conditions which were made as much as possible like those present in the ordinary foundry plant. A Cooper-Hewitt lamp in operation was exhibited in the auditorium. At a short business meeting preceding the consideration of the subject of the evening, several new names were admitted to membership.

## DEATH OF PRESIDENT OF CRUCIBLE STEEL CO.

Frank Biddle Smith, president of the Crucible Steel Co. of America, died unexpectedly at his home at Sewickley, Pa., Dec. 30, from a stroke of apoplexy. He was 50 years of age. Mr. Smith's business life, all of which was spent in the iron and steel industry, was an eventful one, and his advance to the high position held at his death was in logical relation to his ability and persevering energy. He was regarded as one of the leaders of the crucible steel industry of the United States.

Mr. Smith was born in Allegheny, Oct. 1, 1859, and was the son of Andrew D. Smith, one of the prominent steel men of his time. He attended private grammar school and then entered the Western University of Pennsylvania, spending seven years and being graduated with the class of 1877. Immediately thereafter he entered the employment of his father's firm, which was known as Smith, Sutton & Co., and gradually worked his way to a high position. Later the firm became Smith Bros. & Co., and finally the business was taken over by the La Belle Steel Co., a new corporation. Mr. Smith

FRANK B. SMITH.

became president of this company. Upon the formation of the Crucible Steel Co. of America in August, 1900, the La Belle Steel Co. was absorbed and Mr. Smith became the secretary of the company. Subsequently he was promoted to the position of assistant to the president and general manager. In May, 1903, he was elevated to the presidency of the company.

In addition to his connection with the crucible steel business Mr. Smith had been a factor of prominence in the railway steel spring business. He organized the Railway Steel Spring Co., which took over the A. French Spring Co. of Pittsburg and many similar concerns throughout the United States. Mr. Smith was a member of Pittsburg's leading clubs. He came of a prominent family and was the brother-in-law of Secretary of State Philander C. Knox. His death was the third among the executives of the Crucible Steel Co. of America within a period of little more than a year, the others having been Wm. G. Park, chairman of the board,

## CONSTRUCTING 46 VESSELS

### In Lake Ship Yards for This Year's Delivery—Ore Carrying Capacity to be Greatly Increased.

The ship yards of the great lakes have 46 vessels under construction for 1910 delivery, including 22 bulk freighters, five package freighters, five passenger boats, one ferry steamer, six tugs, two hopper barges, one fire boat, one lighter, one light vessel, one lighthouse tender and one scow.

Of this program, the American Ship Building Co. is building 20, the Great Lakes Engineering Works, Detroit, nine; the Toledo Ship Building Co., Toledo, O., three; the Manitowoc Dry Dock Co., Manitowoc, Wis., two; the Racine Boat Manufacturing Co., Muskegon, Mich., two; Johnston Bros., Ferrysburg, Mich., five; Collingwood Ship Building Co., Ltd., Collingwood, Ont., three; and the Toronto Ship Yards, Toronto, Ont., two.

Again sub-dividing the program, the American Ship Building Co.'s new construction consists of 12 bulk freighters, four package freighters, two passenger boats, one fire boat and one ferry steamer. The Great Lakes Engineering Works have under construction eight bulk freighters and one package freighter. The Toledo Ship Building Co. is building a bulk freighter, a lumber steamer and an excursion steamer; the Manitowoc Dry Dock Co., a passenger steamer and a lighter; the Racine Boat Manufacturing Co. a light vessel and a lighthouse tender; Johnston Bros., five tugs; the Collingwood Ship Building Co., Ltd., a tug and two hopper barges; and the Toronto Shipyards, one passenger steamer and one scow.

The 22 bulk freighters included in this program have a carrying capacity of 203,740 tons of ore in a single trip, or 4,074,800 tons in an average season.

In the past eight years, vessels having a gross carrying capacity of 37,013,200 gross tons in a full season have been added to the available ore-carrying fleet. The 1910 program will increase this to 41,088,000 tons, which is more ore than was carried down in any one year with the exception of 1907 and 1909, when 41,288,755 and 41,683,873 tons, respectively, were moved.

**Iron Mine Photos.**—The photographs used to illustrate the article beginning on page 53 entitled "Great Achievements on the Iron Ranges" were supplied to THE IRON TRADE REVIEW by the *Duluth News Tribune* from its extensive collection of iron range pictures made during the autumn of 1909.

# Pig Iron Record of 1909 Passed 1907

The total production of coke and anthracite pig iron for the year 1909 was 25,337,002 tons. Estimating the production of the charcoal stacks for the same year at 400,000 gives the grand total of coke, anthracite and charcoal pig iron of the United States for 1909 as 25,737,000 tons. The total production of coke and anthracite iron in the first half of 1909 was 10,820,672 tons; and in the last half, 14,516,330 tons.

Presentation of these figures is made possible by the receipt of complete returns from the blast furnaces of the country, through the hearty co-operation of owners, managers and superintendents, through the medium of the mail, telephone and telegraph. These returns show that the total production of coke and anthracite iron in December was 2,682,702 tons, December being the fourth successive month in the second half of 1909 to break the record production of October, 1907. The average daily production for December was 86,539 tons, compared with the average daily production of November of 84,425 tons.

MONTHLY PRODUCTION.

| | 1909. | 1908. | 1907. |
|---|---|---|---|
| January | 1,788,164 | 1,043,374 | 2,194,801 |
| February | 1,682,470 | 1,086,809 | 2,047,036 |
| March | 1,822,644 | 1,229,856 | 2,216,709 |
| April | 1,730,603 | 1,155,122 | 2,226,703 |
| May | 1,866,737 | 1,168,002 | 2,291,030 |
| June | 1 930,029 | 1,106,300 | 2,237,420 |
| July | 2,038,620 | 1,228,604 | 2,253 243 |
| August | 2,232,642 | 1,366,019 | 2,243,656 |
| September | 2,375,589 | 1,416,252 | 2,174,148 |
| October | 2,604,037 | 1,573,824 | 2,359,690 |
| November | 2,532,740 | 1.582,314 | 1,820,558 |
| December | 2,682,702 | 1,723,664 | 1,234,733 |
| Total | 25,337,002 | 15,680,140 | 25,299,732 |

The total production of coke and anthracite iron for 1909 exceeded the record production of 1907 by 37,270 tons. It exceeded the production of 1908 by 9,656,862 tons. A comparison of figures shows that all the record breaking was done in the last half of the past year. For, while the first half of 1907 exceeded that of 1909 by a production of 2,393,032 tons, yet the last half of 1909 exceeded the last half of 1907 by a total of 2,430,302 tons. In other words, the last half of 1909 exceeded the first half of 1909 by a total of 3,695,658 tons. The increase of the first half of 1909 over the first half of 1908 was 4,031,209 tons; while the increase of the second half of 1909 over the second half of 1908 was 5,625,653 tons.

The total output of the merchant stacks in 1909 was 8,202,014 tons, divided into 3,694,374 tons in the first half and 4,507,640 tons in the second half. The total production of non-merchant or steel plant furnaces in 1909 was 16,847,531 tons, divided into 7,004,064 tons in the first half and 9,843,467 tons in the second half. The merchant furnaces in the second half made a gain over the first half of 813,266 tons, while the non-merchant stacks made a gain in the second half over the first of 2,839,403 tons, so that the steel plant stacks, or non-merchant, gained 2,026,137 tons over the merchant stacks in 1909. The total production of ferro in 1909 showed a gain over the production in 1907 of 2,946 tons, and over the production of 1908 of 32,816 tons. The total production of spiegel in 1909 fell below the total production of spiegel in 1907 by 160,681 tons; but exceeded the production in 1908 by 11,373 tons.

AVERAGE DAILY PRODUCTION.

| | 1909. | 1908. |
|---|---|---|
| January | 57,683 | 34,316 |
| February | 60 088 | 37,476 |
| March | 58,795 | 39,672 |
| April | 57,687 | 38,504 |
| May | 60,218 | 37,677 |
| June | 64,334 | 36,876 |
| July | 67,375 | 39,632 |
| August | 72,021 | 44,065 |
| September | 79,186 | 47,208 |
| October | 84,001 | 50,764 |
| November | 84 425 | 52,744 |
| December | 86,539 | 55,602 |

In December, all states and groups of states showed gains in output over the November production except Alabama, New York, New Jersey and the Kentucky group. The production of spiegel in December, compared with that of November, showed a falling off of 3,843 tons, while ferro in December gained exactly 2,000 tons. In the following states, a total of 12 stacks was added to the active list in December: Illinois, five; Pennsylvania, four; Indiana, Virginia and Michigan, one each. In December a total of nine stacks was blown out in the following states: Alabama, three; Ohio, New Jersey, Kentucky, West Virginia, Georgia and Texas, one each, so that December made a gain over November of three active stacks, bringing the total in operation on the last day of December up to 314.

The following comparisons of the number of stacks active and the total theoretical percentage of output possible to be made with the number of stacks in existence from month to month are interesting:

| | 1908. No. stacks active. | 1908. Percentage of possible output. | 1909. No. stacks active. | 1909. Percentage of possible output. |
|---|---|---|---|---|
| January | 139 | 35.0 | 234 | 56.3 |
| February | 152 | 37.7 | 233 | 57.3 |
| March | 154 | 40.4 | 229 | 56.9 |
| April | 146 | 36.8 | 224 | 54.8 |
| May | 146 | 36.2 | 236 | 56.6 |
| June | 154 | 37.4 | 240 | 57.9 |
| July | 166 | 39.9 | 258 | 60.7 |
| August | 181 | 43.3 | 278 | 65.0 |
| September | 189 | 46.3 | 297 | 70.3 |
| October | 200 | 48.6 | 309 | 73.7 |
| November | 212 | 51.1 | 311 | 74.9 |
| December | 221 | 55.6 | 314 | 75.9 |

AVERAGE PERCENTAGE OF POSSIBLE OUTPUT.

| 1908. | | 1909. | |
|---|---|---|---|
| First half | 37.25 | First half | 56.63 |
| Second half | 47.46 | Second half | 70.08 |

## SPRING MEETING.

New York, Jan. 5. (By wire.)

The Spring meeting of the American Society of Mechanical Engineers will be held at Atlantic City, May 31 to June 3 inclusive, with headquarters at the Marlborough Blenheim.

## DECEMBER FURNACE REPORT.

| STATES. | NO. OF STACKS. | NO. IN BLAST ON LAST DAY OF MONTH. DEC. | NO. IN BLAST ON LAST DAY OF MONTH. NOV. | PERCENTAGE OF TOTAL POSSIBLE OUTPUT. | AV. DAILY CAPACITY IN BLAST LAST DAY OF MONTH. | ACTUAL TONNAGE MAKE. MERCHANT. | ACTUAL TONNAGE MAKE. NON-MERCHANT. | TOTALS. DEC. | TOTALS. NOV. |
|---|---|---|---|---|---|---|---|---|---|
| Pennsylvania | 156 | 130 | 126 | 83.4 | 35,412.0 | 282,397 | 848,269 | 1,080,666 | 1,030,276 |
| Ohio | 68 | 61 | 62 | 89.6 | 22,161.3 | 270,591 | 412,756 | 683,347 | 592,339 |
| Alabama | 46 | 27 | 30 | 60.4 | 5,445.9 | 139,932 | 33,770 | 173,702 | 182,185 |
| Virginia | 24 | 13 | 12 | 51.1 | 1,394.9 | 40,779 | ——— | 40,779 | 35,877 |
| New York | 26 | 17 | 17 | 65.4 | 5,280.2 | 70,633 | 93,042 | 163,675 | 176,029 |
| New Jersey | 9 | 5 | 6 | 63.9 | 964.5 | 35.509 | ——— | 35,509 | 36,444 |
| Illinois | 26 | 23 | 18 | 85.6 | 8,132.8 | 30,354 | 210,389 | 240 743 | 220,032 |
| Colorado | 6 | 3 | 3 | | | | | | |
| Indiana | 7 | 7 | 6 | 77.4 | 4,732.2 | 21,234 | 123,938 | 145,172 | 138,965 |
| Maryland | 4 | 3 | 3 | | | | | | |
| Wisconsin | 6 | 5 | 5 | | | | | | |
| Kentucky | 7 | 1 | 2 | | | | | | |
| W. Virginia | 4 | 3 | 4 | 59.1 | 2,180.8 | 42,304 | 29,345 | 71,649 | 75,910 |
| Tennessee | 18 | 12 | 12 | | | | | | |
| Georgia | 2 | 0 | 1 | | | | | | |
| Texas | 3 | 0 | 1 | | | | | | |
| Minnesota | 1 | 1 | 1 | 50.9 | 580.8 | 20 622 | ——— | 20,622 | 19,002 |
| Michigan | 2 | 2 | 1 | | | | | | |
| Missouri | 1 | 1 | 1 | | | | | | |
| Spiegel—All states | | | | | | | | 11,213 | 15,056 |
| Ferro—All states | | | | | | | | 15,625 | 13,625 |
| Total | 416 | 314 | 311 | 75.9 | 86,067.4 | 904,355 | 1,751,509 | 2,682,702 | 2,532,740 |

## CANADIAN MERGERS

### Of Several Kinds Contemplated, But Some Reports Exaggerated.

Toronto, Canada, Jan. 3.

A statement which is obtaining extensive circulation as to the approaching merger of all the Canadian steel companies with a capitalization of $500,000,000, while it has some foundation in fact, is greatly exaggerated. There are several merger projects in process of arrangement, but no such all-embracing scheme as has been outlined in the current reports is as yet under contemplation. The mergers now being carried out are as follows:

First.—The Dominion Iron & Steel and Dominion Coal companies, of which the details are now being arranged so far as these two companies are concerned, the steel interests having secured absolute control of the coal company. Negotiations are under way to include the Nova Scotia Steel & Coal Co. and also to absorb several wire manufacturing concerns. This step will enable the steel company to market its output in the form of finished products instead of selling its pig iron, steel billets and wire rods, and is rendered necessary by other mergers, which must tend to limit their market for steel and iron in the first stages of manufacture.

Second.—A merger has been practically arranged between the Hamilton Steel & Iron Co., the London Rolling Mills, the Ontario Steel Co. of Welland, the Page Hersey Co. of Guelph, the Canada Screw Co. of Hamilton, and the Ontario Tack Co. of Hamilton. It is understood that William McMaster, president of the Montreal Rolling Mills, will be president. The construction of a new wire rod mill and other plants has been ordered.

Third.—The Algoma Steel Co. is extending its operations so as to include finished products other than steel rails. Contracts have been let to Mackintosh, Hemphill & Co., Pittsburg, for the construction of a 22-inch mill and a 14-inch rolling mill, and a rod mill will also be built. In addition the company is seeking to secure the control of finishing plants to include one rolling mill, a bolt and nut concern, and three or four wire plants. Negotiations with that object have been opened.

The result of these amalgamations will be the absorption of nearly all blast furnace products by the steel works embraced in the respective mergers. The Sault Ste. Marie plant will take the output of the Atikokan and Midland blast furnaces as well as that of its own furnace. The Hamilton Steel & Iron Co. and associated plants will use the pig produced by the two Hamilton furnaces and will need to go outside for a portion of their raw material. The Dominion Steel and Nova Scotia companies will also require all their own pig and more, the anticipated shortage compelling the construction of a new blast furnace. There will consequently be a decided scarcity of pig iron for foundry purposes and the establishment of a new furnace at some point on the Welland canal to supply this demand is in contemplation.

## AMERICAN BLOWER CO.'S RECORD.

The American Blower Co., Detroit, Mich., and Troy, N. Y., has issued a holiday booklet to be distributed among its employes, to all of whom the company gives each Christmas as many dollars as they have been years in the company's service. The American Blower Co. was founded as a partnership in 1884 and has been in business continuously since. The booklet contains historical matter, portraits of the officers, of some of the older employes, of the whole working force of 17 men employed in 1885, and of Samuel C. Davidson, inventor of the Sirocco blower made by the company. During the 25 years of the company's life there have been no serious labor difficulties, the company has defended but one personal injury suit, and no man was ever killed in the works.

## GROUND BROKEN FOR NEW PULLMAN SHOPS.

San Francisco, Dec. 29.—Ground was broken yesterday morning at Richmond, a suburb of San Francisco, for the new shops of the Pullman Car Co. by a gang of workmen numbering several hundred. Work will be hurried along with all possible speed, and it is expected that the foundations for the machine and car shops will have been started within the first days of tthe new year.

The site of the shops is part of what was formerly occupied by the Ghirardelli Cocoa Co.'s big plant.

Copper exports for December were 28,104 tons, against 21,890 in December, 1908, an increase of 6,214 tons. For the year 1909 the copper exports were 301,657 tons, compared with 290,243 in 1908, an increase of 11,414 tons.

## NEW FREIGHT RATES.

### Will Have an Important Bearing on Pig Iron Movement.

An advance Jan. 1 in the freight rates on imported pig iron, ferro-manganese and ferro-silicon from seaboard to inland points will have an important bearing upon the bringing in of foreign material to consumers' plants located at distance from the eastern coast because of the increased delivered price. Heretofore, the freight rates on imported material have been less than those upon the domestic, but the two schedules are now put upon the same basis. The new import and domestic rates per ton from Philadelphia are as follws:

| | Pig iron. | Ferro-manganese. | Ferro-silicon (in pigs.) |
|---|---|---|---|
| Pittsburg | $2.25 | $2.40 | $2.25 |
| Cleveland | 2.97 | 2.97 | 2.97 |
| Canton | 2.97 | 2.97 | 2.97 |
| Chicago | 4.35 | 4.35 | 4.35 |
| Milwaukee | 4.35 | 4.35 | 4.35 |

The former import rates per ton from Philadelphia were as follows:

| | Pig iron. | Ferro-manganese. | Ferro-silicon (in pigs.) |
|---|---|---|---|
| Pittsburg | | $2.15 | $2.15 |
| Cleveland | $2.60 | 2.62 | 2.62 |
| Canton | 2.60 | 2.62 | 2.62 |
| Chicago | 3.70 | 3.65 | 3.65 |
| Milwaukee | 3.70 | 3.65 | 3.65 |

The new import and domestic rates per ton from Baltimore are as follows:

| | Pig iron | Ferro-man ganese | Ferro-silicon in packages electrolytic | Ferro-silicon (in pigs.) |
|---|---|---|---|---|
| Pittsburg | $2.15 | $2.30 | $2.30 | $2.15 |
| Cleveland | 2.77 | 2.95 | 2.95 | 2.77 |
| Canton | 2.77 | 2.95 | 2.95 | 2.77 |
| Chicago | 4.15 | 4.40 | 4.40 | 4.15 |
| Milwaukee | 4.15 | 4.40 | 4.40 | 4.15 |

The former import rates on ferro-manganese and ferro-silicon per ton from Baltimore have been as follows:

| | Ferro-manganese. | Ferro-silicon. |
|---|---|---|
| Pittsburg | $1.95 | $1.95 |
| Cleveland | 2.42 | 2.42 |
| Canton | 2.42 | 2.42 |
| Chicago | 3.45 | 3.45 |
| Milwaukee | 3.45 | 3.45 |

There also has gone into effect an advance of the all rail rates from New Orleans. On ferro-manganese the new rate from New Orleans to Chicago and Milwaukee is $3.80 a ton compared with $2.85, the former rate. From New Orleans to St. Louis it is an advance from $3.57 to $4.65 a ton.

## READING DISTRICT FURNACES ARE BUSY.

Reading, Pa., Jan. 4.—There was no change in the blast furnace situation in this district during the month of December. With few exceptions, all stacks are running full. Keystone furnace of the Reading Iron Co. in this city was closed down for a short time on account of repairs, but is active again. The Reading Iron Co. is preparing to put the Emaus stack in blast about Feb. 1.

# Chronology of the Iron and Steel Business for the Past Year

## January.

1—E. W. Pargny succeeds C. W. Bray as president of the American Sheet & Tin Plate Co. Jas. N. Swank resigns as general manager of the American Iron & Steel Association.

4—Donora, Pa., works, American Steel & Wire Co. resumes operations after long idleness.

5—First ore sale of the year reported, 50,000 tons of non-Bessemer.

7—Pennsylvania lines west enter the market for 2,600 freight cars.

8—Over production of coke weakens the spot furnace market and operators adopt a price of $1.75 at ovens.

9—American Locomotive Co. announces plans for the building of a large plant at Gary, Ind.

11—Joseph Wharton, president of the Wharton Steel Co. and of the American Iron and Steel Association, dies at Philadelphia. First rail mill at Gary plant of the Indiana Steel Co. is started. Bi-monthly examination discloses 1.30c bar iron card and $5.25 puddling rate; sheets and tin plate rates remain at base.

12—New York Central inquires for 80,000 tons of rails. Other rail inquiries aggregating 30,000 tons come out.

13—Pennsylvania Railroad Co. announces its rail specifications and files first order against its contract with the mills.

14—United States Steel Corporation for the first time offered common stock to employes, 15,000 shares at 50 and 18,000 shares of preferred at 110.

15—West Penn Steel Co. announces plans for new sheet mill at Brackenridge, Pa.

16—New York State Steel Co., Buffalo, is reorganized.

18—Rebuilt Scottdale furnace of Corrigan, McKinney & Co. is blown in. Independent sheet makers reaffirm prices.

19—Nut, bolt and rivet prices are reaffirmed. New York Central lines buy 2,000 steel cars. Wm. G. Park, chairman of Crucible Steel Co. of America, dies at Pittsburg.

20—Carnegie Steel Co. closes contract for steel wheel requirements of Chicago City Railway Co.

25—Carnegie Steel Co., starts first of 12 new open-hearth furnaces at Ohio works, Youngstown, placing it in position to roll open-hearth rails in one plant. New iron plant of A. M. Byers & Co. at Girard, O., begins operations. Herbert DuPuy elected chairman of Crucible Steel Co. of America.

26—United States Steel Corporation's report for last quarter of 1908 shows net earnings of $21,011,663 and unfilled tonnage of 3,603,527.

27—Increased evidence of shading of prices of finished materials shown by market.

29—Pennsylvania lines west order 2,200 freight cars and Chesapeake & Ohio 500 cars.

30—Baltimore & Ohio places contract for 37,000 tons of Bessemer and open-hearth rails.

## February.

1—Valley makers announce pig iron averages for January as $15.50 valley on basic and $16.44 valley on Bessemer.

4—Inter-Ocean Steel Co. announces plans for erection of new plant at Chicago Heights, Ill., for manufacture of steel tires, car equipment, etc.

5—Six new open-hearth furnaces started at Duquesne plant of the Carnegie Steel Co.

8—Pig iron prices sag in a dull market.

9—Market in finished steel lines continues to drag, and price concessions are general.

10—New No. 6 furnace at the Ohio works, Youngstown, of the Carnegie Steel Co. blown in.

14—DeForest Sheet & Tin Plate Co. announces plans for new sheet and tin mills at Niles, O.

15—Three open-hearths started and first steel is made at Gary plant of Indiana Steel Co.

16—Pennsylvania Railroad Co. orders 2,400 all-steel gondolas.

17—Distribution of New York Central rail order aggregating 101,000 tons is announced.

19—Open market is declared on all iron and steel finished products except rails.

20—Reductions announced of $4 in steel bars from 1.40c to 1.20c; of $6 in plates and shapes from 1.60c to 1.30c; of $4 in hoops from 1.80c to 1.60c; of $6 to $10 in steel pipe and boiler tubes and of $2 to $4 in iron pipe.

22—Finished market continues in a confused state awaiting further developments.

24—Notice given of abrogation of conciliation and continuous working agreement between Amalgamated Association of Iron, Steel and Tin Workers and Western Bar Iron Association at the expiration of wage scale July 1.

25—Bar iron makers cut prices $2 a ton and establish market at 1.40c Pittsburg, 1,40c Chicago and 1.40c St. Louis.

26—Large foundry coke contracts calling for 65,000 tons for extended requirements of large western consumers closed with Pittsburg interests.

27—Makers of cold rolled strip steel reduce prices $6 a ton.

## March.

1—Machine tool builders at a meeting in New York reaffirmed prices.

2—Independent sheet makers meet in Pittsburg and announce reductions of $2 to $4 a ton in black, $4 to $6 a ton in galvanized and $2 to $4 a ton in corrugated roofing.

3—Billet and sheet bar prices are established at $23 and $25 Pittsburg respectively, with full freight added.

4—Independent iron pipe makers announce reductions of $6 to $8 a ton.

8—Independent ore interest sells block of 250,000 tons of Superior ore at 20 cents under the prevailing schedule.

9—Wire products show a firmer price condition and $1.95 on nails is better held.

10—Sheet tonnage shows improvement and mill operations are increased.

11—Iron boiler tube makers announce reductions of $6 to $10 a ton.

12—Tin plate prices are reduced $5 a ton.

15—Carnegie Steel Co. enters contracts for about 30,000 steel wheels.

16—Steel makers report largest weekly tonnage of orders entered in 18 months. Annual report of United States Steel Corporation for 1908 shows net earnings of $74,882,529.

17—Payne tariff bill introduced in congress, recommending large reductions in the iron and steel schedule.

18—Bi-monthly settlement made at $5.37½ based upon 1.35c bar iron card. Sheet and tin plate rates remain at base.

19—Wage reductions among blast furnace and steel mill employes in Pittsburg and valley territories are indicated. Thos. F. Cole resigns as president of the Oliver Iron Mining Co. and is succeeded by W. J. Olcott.

20—Rather gloomy sentiment pervades iron and steel industry over proposed tariff reductions.

22—New York Central lines enter the market for 35,000 tons of bridge work.

23—Negotiations opened for the consolidation of independent coking operations in the upper and lower Connellsville regions.

24—Pig iron makers meet in Cleveland and protest against proposed 50 cent duty on scrap.

25—Wide-spread reports of severe cutting of iron and steel prices.

26—Republic Iron & Steel Co. announces 10 per cent reduction in wages effective April 1.

27—Jones & Laughlin Steel Co. floats $15,000,000 bond issue for new construction work.

29—United States Cast Iron Pipe & Foundry Co. books 45,000-ton cast iron pipe contract and covers for southern iron, starting buying movement in latter.

30—Cotton tie market of the year opens at lower prices than 1908.

31—M. A. Hanna & Co. announce plans for erection of additional blast furnace at Detroit by the Detroit Iron & Steel Co. Corrigan, McKinney & Co. award contracts for new furnace at Cleveland.

## April.

1—Numerous reductions of 10 per cent in blast furnace and steel works wages go into effect in Pittsburg eastern and western districts.

2—Isthmian Canal Commission enters market for large assortment of iron and steel material for full year's delivery.

3—Reports of selling of steel bars down to 1.10c Pittsburg and plates and shapes to 1.20c Pittsburg disturb the market.

5—Revised rail specifications announced by makers.

6—Denver & Rio Grande railroad places order for 1,500 steel cars with the Pressed Steel Car Co.

7—Announcement made of proposed erection of new independent tin plate plant near Hollidays Cove, W. Va.

9—More evidence of 1.10c Pittsburg selling of steel bars to be noted in the market.

12—New York Central lines award contracts for 39,000 tons of structural material.

13—Independent sheet makers meet at Pittsburg and reaffirm prices.

15—Hazelton Steel Tube Co., subsidiary of Republic Iron & Steel Co., announces plans to erect new tube works near Youngstown, O.

16—Market in wire products much disturbed by price concessions in nails and wire.

17—Association of American Steel Manufacturers meets in Pittsburg and re-elects officers.

19—Pig iron market takes on renewed life. There is greater buying and a heavy inquiry appears.

20—W. P. Snyder & Co., Pittsburg, announce ore sales aggregating 330,000 tons for season beginning May 1.

21—Some leading Pittsburg steel bar makers now more openly quoting 1.10c Pittsburg.

22—Southern iron generally advanced to $11.50 Birmingham for No. 2.

23—Important purchases of pig iron made including 24,000 tons of northern and southern foundry by Massillon Iron & Steel Co., 13,500 tons of malleable and foundry by International Harvester Co., and 10,000 tons of basic by American Steel Foundries Co.

24—Some large steel makers decline to meet low prices in bars, shapes and plates and are quoting minimums of 1.15c Pittsburg and 1.25c Pittsburg, respectively.

26—Phillips Sheet & Tin Plate Co. formally announces its connection with proposed new independent tin plate plant at Hollidays Cove, W. Va.

30—Jones & Laughlin Steel Co. orders active resumption of construction work at new Aliquippa, Pa., plant.

## May.

1—Additional wage reductions made by iron and steel manufacturers. Western Bar Iron Association asks for 10 per cent reductions in iron boiling and finishing scales. Cuts announced of $7 on nails, $8 on plain wire and $10 on barb wire.

3—Announcement made that Jones & Laughlin Steel Co. proposes to erect large tin plate plant at Aliquippa, Pa., first unit to consist of 10 mills.

4—Annual convention of Amalgamated Association of Iron, Steel and Tin Workers opens at Detroit.

5—Light rail prices advance $2 to $3 a ton.

6—St. Paul railroad reports purchase of 65,000 tons of rails.

7—Steel bar prices settle on a basis of 1.20c Pittsburg.

8—United States Steel Corporation announces appropriation of $6,000,000 for the building of 560 by-product coke ovens at Gary.

10—Outlook of iron and steel market most favorable since fall of 1907. United States Steel Corporation operating 69 per cent of blast furnace capacity. Bi-monthly settlement shows $5.25 puddling rate based on a 1.30c bar iron card. Sheet and tin plate rates continue at base.

11—Announcement made that 1907 Lake Superior ore prices have been re-affirmed and sales of nearly 2,000,000 tons have been closed.

12—Northern pig iron prices advanced by a number of makers.

13—Jones & Laughlin Steel Co. completes four additional Talbot open-hearth furnaces at South Side plant, Pittsburg, and fires the new capacity.

14—Steel companies which reduced wages make announcement of re-adjustment June 1.

15—Heavy buying of basic pig iron noted in eastern market.

17—American Steel & Wire Co. advances wire products $2 a ton. Republic Iron & Steel Co. and Cambria Steel Co. advance steel bars to 1.25c Pittsburg.

18—Amalgamated Association of Iron, Steel and Tin Workers adjourns annual convention after re-affirming 1908 scale of wages.

19—Pullman company announces intention to proceed with erection of large steel car shops in the Chicago district. H. H. Rogers, director of the United States Steel Corporation, dies.

21—Jones & Laughlin Steel Co. closes long-term coke contract with Thompson-Connellsville Coke Co. for requirements of its new Aliquippa furnaces.

22—Ohio Fuel Supply Co. contracts for 85 miles of 16-inch pipe for gas line from West Virginia to Ohio points.

24—Bellaire, O., steel works of Carnegie Steel Co. resumes after an idleness of 17 months.

25—Orders issued to start blast furnaces and plant of Riverside works of National Tube Co. at Benwood, W. Va., after an idleness of 20 months.

26—Amalgamated Association of Iron, Steel and Tin Workers conference with Western Bar Iron Association on annual wage scales at Detroit.

27—Pittsburg ore interest announces sales of 500,000 tons and its withdrawal from the market. Sante Fe system places orders for 47,000 tons of rails with the Illinois Steel Co.

28—National Tube Co. fires its two idle blast furnaces at its Riverside works, Benwood, W. Va.

29—Conference of Amalgamated Association of Iron, Steel and Tin Workers and Western Bar Iron Association adjourns without reaching wage agreement.

31—Tonnage of orders placed with the mills in May announced as largest in two years.

## June.

1—American Sheet & Tin Plate Co. posts notice of its desire to withdraw from wage agreements with Amalgamated Association of Iron, Steel and Tin Workers expiring June 30, and to operate its plants as open shops.

2—Announcemet made of numerous car orders placed and pending.

3—Carnegie Steel Co. continues to increase active blast furnace capacity and announces furnace operations at about 80 per cent.

5—Orders placed in the east for seven steel ocean vessels requiring about 40,000 tons of material.

7—Jones & Laughlin Steel Co. and other independent plate and shape makers raise prices to 1.35c Pittsburg.

8—Harriman lines place orders for 150,000 tons of rails.

11—Bar iron makers advance prices to 1.45c Pittsburg.

14—Amalgamated Association of Iron, Steel and Tin Workers holds delegate convention in Pittsburg to act upon American Sheet & Tin Plate Co.'s open shop order.

15—Maryland Steel Co. breaks ground for new open-hearth plant at Sparrows Point, Md.

16—Amalgamated Association of Iron, Steel and Tin Workers formally decides to resist open shop policy of American Sheet & Tin Plate Co.

17—Railroads freely enter the market for rails and steel cars.

19—Some makers of iron pipe advance quotations $2 a ton.

21—Jones & Laughlin Steel Co. announces experiments with duplex process of steel making at its South Side plant, Pittsburg.

23—Republic Iron & Steel Co. notifies Amalgamated Association of Iron, Steel and Tin Workers that it desires to operate its Sylvan and Brown-Bonnell plants as open shops.

24—Jones & Laughlin Steel Co. awards contracts for 10-mill tin plate plant at Aliquippa, Pa.

25—Western Bar Iron Association and Amalgamated Association of Iron, Steel and Tin Workers reach agreement on iron boiling and finishing scales at practically 1908 basis.

26—Jones & Laughlin Steel Co. buys 25,000 tons of Bessemer iron for third quarter shipment at $15.25 valley.

28—M. A. Hanna & Co. acquire controlling interest in United Iron & Steel Co., Pittsburg.

30—Independent sheet and tin plate makers fix annual agreements with Amalgamated Association of Iron, Steel and Tin Workers, adopting 1908 scales.

## July.

1—Strike of Amalgamated Association of Iron, Steel and Tin Workers inaugurated against 14 union plants of the American Sheet & Tin Plate Co.

3—Independent makers raise prices on steel bars to 1.30c Pittsburg and shapes and plates to 1.35c Pittsburg. following advance of leading interest to 1.25c and 1.30c, respectively.

6—International Harvester Co. makes heavy purchases of northern and southern pig iron estimated at 140,000 tons. American Radiator Co. buys 40,000 tons of foundry grades.

7—Standard Oil interests place orders for 125 miles of 16-inch line pipe for Texas delivery with the National Tube Co.

8—United States Steel Corporation announces plans for construction of large tin plate and sheet mills at Gary.

9—Pig iron production of the United States for first half announced at about 11,000,000 tons.

12—Independent makers quote 1.40c on plates and shapes while leading interest advances to 1.35c.

13—Youngstown Sheet & Tube Co. buys 25,000 tons of Bessemer pig iron from the Bessemer Pig Iron Association for first half shipment at $15.50 valley.

14—Inland Steel Co. awards contracts for doubling sheet capacity at Indiana Harbor, Ind. Serious strike troubles begin at plants of Pressed Steel Car Co. at McKees Rocks, Pa., and Standard Steel Car Co. at Butler, Pa. Rioting ensues and state constabulary is called out.

15—Tin Plate Workers' Protective Association of America, the tin house organization, joins in the strike against the open shop policy of the American Sheet & Tin Plate Co.

16—Jones & Laughlin Steel Co. places numerous contracts for new Aliquippa plant and announces intention to become a maker of wire products. Republic Iron & Steel Co. signs wage agreement with the Amalgamated Association of Iron, Steel and Tin Workers on the same basis as 1908 scale.

17—Youngstown Sheet & Tube Co. declares for open shop in its sheet mill and is struck by Amalgamated Association of Iron, Steel and Tin Workers. Promoters of proposed Connellsville coke merger make modified offer of payment in cash and stock to plant owners.

19—Republic Iron & Steel Co. places contracts for a four-furnace tube plant to be erected at Lansingville near Youngstown, O.

20—Labor troubles seriously engross the attention of the iron and steel industry.

21—Billet prices continue to advance and the $23 Pittsburg nominal quotation disappears along with the arrangement for dividing freight with buyers which had been in effect during the depression. Bessemer billets quotable at $24 to $25 Pittsburg and open-hearth billets at from $25 to $26 Pittsburg.

22—McKeesport Tin Plate Co. awards contracts for the doubling of its tin plate capacity at Port Vue, Pa., to 20 hot mills.

23—Contracts awarded by Carnegie Steel Co. for equipping plant at Homestead works for the manufacture of steel wheels by the Slick process.

26—Wire products advanced $2 a ton.

27—United States Steel Corporation reports second quarter earnings as $29,340,491; unfilled tonnage 4,057,936 and puts common stock upon a 3 per cent basis.

28—Iron mills sign puddling scale of Sons of Vulcan at $5.12½ on a 1.00c bar iron card and resume operations.

30—Conference tariff report made to congress practically embodying proposed reductions of the senate bill.

31—Pennsylvania railroad system enters the market for 8,000 freight cars. Pig iron production of the United States Steel Corporation in July announced as 1,030,000 tons, breaking former record rate of 1,008,000 tons in October, 1906.

## August.

2—Leading interest advances steel bars to 1.30c Pittsburg and plates and shapes to 1.40c Pittsburg. Some independent makers put up steel bars to 1.35c. Light rails advanced $1 a ton. Calvin Wells, president of Pittsburg Forge & Iron Co. and pioneer steel man, dies.

3—Announcement made of purchase of 400,000 tons of Spanish ore by eastern furnaces.

4—Standard Steel Car Co. announces plans for building new open-hearth works and slabbing mill at Butler, Pa.

5—Tariff bill passes the senate and becomes a law by president's signature showing reductions in iron and steel products. Southern Iron & Steel Co. announces plans for new rod, wire and nail mills at Gadsden, Ala.

6—Leading scrap consumers in eastern territory adopt plan of associated buying.

9—Republic Iron & Steel Co. and Youngstown Sheet & Tube Co. buy 30,000 tons of Bessemer iron.

10—Railroads order about 60,000 tons of rails and large number of new cars.

11—Bethlehem Steel Co. announces big program of improvements at South Bethlehem, Pa., including two blast furnaces, steel making and finishing capacity.

12—Youngstown Sheet & Tube Co. sells Alice furnace at Sharpsville, Pa., to the Thos. D. West Foundry Co. and announces plans for erection of new stack at Youngstown.

13—Rail makers open their books for 1910 delivery. Leading interest again advances steel bars to 1.35c Pittsburg.

14—Baltimore & Ohio railroad places order for about 5,000 new cars.

16—Domestic buyers of iron and steel products carefully investigate opportunities for profitable purchases in foreign markets under reduced duties.

17—Manufacturers advance nuts $4 a ton and bolts 7½ per cent making 10 per cent advance in bolts during month. Independent tin plate makers ask premiums on quick shipments.

18—United States Steel Corporation buys 25,000 tons monthly of Connellsville furnace coke for remainder of the year.

19—Sheet business in August running at the heaviest rate of any August in history.

20—Rail makers book 145,000 tons from Sante Fe and 60,000 tons from Chicago & Northwestern for 1910 delivery.

21—Coke market grows stronger and prices begin to advance.

23—Severn P. Ker resigns as general manager of sales of Republic Iron & Steel Co. effective Oct. 1 to become general manager of Sharon Steel Hoop Co.

24—Announcement of adoption of duplex method of steel making by some eastern companies after successful experiments.

25—Connellsville furnace coke prices advance to $2.50 ovens.

26—Dallas C. Byers, president of A. M. Byers & Co., Pittsburg, dies in France.

27—Large tonnage of foreign ore is purchased by eastern pig iron makers.

30—Officially stated that Buffalo Union Furnace Co. will proceed with the erection of two new blast furnaces at Buffalo,

31—United States Steel Corporation again breaks monthly pig iron record in August with production of 1,090,000 tons.

## September.

1—Oil and gas country pipe advanced $2 a ton.

2—Shafting advanced three points to discounts of 57 and 53.

3—Iron pipe advanced $2 a ton.

4—Coke market considerably excited and sentiment is very bullish.

6—Cambria Steel Co. advances plates and shapes to 1.50c Pittsburg.

7—Basic pig iron advances to $16 valley and Bessemer to $17 valley.

8—Strike at the plant of the Pressed Steel Car Co., McKees Rocks, Pa., is settled.

9—Leading interest advancees shapes and plates to 1.50c Pittsburg and steel bars to 1.40c Pittsburg, aannouncing a new card on bar extras.

13—Jones & Laughlin Steel Co. buys 20,000 tons of Bessemer pig iron for last quarter at $17 valley.

14—Foundry pig iron advances to $16.50 valley.

17—W. P. Snyder & Co., Pittsburg, negotiate sales of 48,000 tons of Bessemer iron.

20—Bessemer iron advances to $18 valley.

21—Advance in sheet prices of $1 a ton on black and $2 a ton on galvanized.

23—Youngstown Sheet & Tube Co. buys 25,000 tons of Bessemer iron for first half at $18 valley. Westinghouse interests contract for 25,000 tons different grades.

24—Upson Nut Co. awards contracts for new open-hearth plant and billet mill at Cleveland.

27—Independent sheet makers post a further advance of $1 a ton on black and $2 a ton on some sizes of galvanized.

28—Leading interest advances black and galvanized sheets $2 a ton and tin plate $2 a ton. Southern iron advances to $15 Birmingham for No. 2.

29—Pennsylvania railroad system announces the placing of its rail order for 1910 aggregating 200,360 tons.

30—Contract for 110 miles of 12-inch and smaller pipe for Texas delivery taken by Spang, Chalfant & Co., Inc., Pittsburg.

## October.

1—Options expire and attempt at independent coke merger proves unsuccessful. Independent steel bar makers put into effect new arrangement of extras. National Tube Co. advances steel merchant pipe and boiler tubes $2 a ton.

2—Total Bessemer sales in valley and Pittsburg territory in September announced as

152,600 tons at an average price of $17.43 valley.

4—Charcoal iron tubes are advanced $4 a ton. Cold rolled strip steel advanced $3 a ton.

5—September pig iron production announced as new high record of the country.

6—Cambria Steel Co. makes purchase of 57,000 tons of Bessemer and basic for last quarter and first half.

7—Carnegie Steel Co. operating the largest percentage of pig iron capacity in its history, which is close to 99 per cent of possible output.

9—Seaboard consumers import moderate quantities of foreign steel.

11—New York Central lines in the market for a large number of cars.

12—Republic Iron & Steel Co. buys 20,000 tons of Bessemer for first quarter delivery at $19 valley.

13—Scarcity of Lake Superior Bessemer ore develops.

14—Shafting prices advance two points to discounts of 55 and 50.

15—Weekly coke production in the Connellsville regions reaches the highest point in history. Independent steel makers tender complimentary dinner to Judge E. H. Gary at New York.

18—New York Central lines place orders for about 10,000 cars.

19—Wire makers open books for first quarter and half shipment to manufacturing trade at an advance of $2 a ton. National Tube Co. advances line pipe $2 a ton.

20—American Bridge Co. announces plans to erect fabricating shop at Gary, Ind., with initial monthly capacity of 10,000 tons. Illinois Steel Co. announces plans for an additional structural mill. Jones & Laughlin Steel Co. buys 20,000 tons of Bessemer for December and January at $19 valley.

21—Bar iron strengthens to basis of 1.65c Pittsburg.

22—Pennsylvania railroad system enters the market for 10,000 additional cars.

23—United States Cast Iron Pipe & Foundry Co. buys 60,000 tons of gray forge pig iron.

26—United States Steel Corporation advances dividend on common stock to 1 per cent quarterly.

28—Youngstown Sheet & Tube Co. buys 40,000 tons of Bessemer for first half at $19 valley.

29—Bethlehem Steel Co. awards contracts for two additional blast furnaces and duplex steel plant at South Bethlehem, Pa.

30—Iron pipe makers advance prices $2 a ton.

### November.

1—October Bessemer sales in Pittsburg and valley territory announced as 165,500 tons with average price of $18.78 valley. DeForest Sheet & Tin Plate Co. starts new sheet mill at Niles, O.

2—Ore carrying rates on lakes advanced 10 cents a ton. Ferro-manganese market excited by some moderate buying of Carnegie Steel Co.

4—Pennsylvania lines west enter market for 5,000 steel freight cars. Announcement of new high coke and anthracite pig iron production record made in October, 2,565,985 tons.

6—Republic Iron & Steel Co. announces large contemplated construction in Youngstown district.

8—Carnegie Steel Co. announces it will proceed with the erection of large additional merchant mill capacity near Girard, O. Bar iron advances to 1.70c Pittsburg.

9—Maryland Steel Co. begins rolling of 45,000 tons of Bessemer billets for western shipment because of light rail tonnage. Jones & Laughlin Steel Co. closes for 20,000 tons of Bessemer iron for early shipment at $19 valley.

10—American Iron & Steel Mfg. Co. announces it will install new steel works and make steel by the electric process. American Steel & Wire Co. announces it will build wire mills at Birmingham, Ala.

11—American Sheet & Tin Plate Co. advances blue annealed sheets $1 a ton, galvanized sheets $3 a ton and tin plate $2 a ton. Independent makers make similar advances.

12—Bi-monthly wage settlement made upon $5.50 puddling rate based upon 1.40c bar iron card. Sheet and tin plate rates continue at base.

13—Pittsburg Steel Co. buys 12,000 tons of basic for shipment the remainder of the year.

15—Bessemer department of the Homestead works of the Carnegie Steel Co. resumes after several years' idleness. Pennsylvania lines west order 27,100 tons of rails of Carnegie Steel Co.

16—Santa Fe system places order for 10,000 freight cars. American Bridge Co. awarded 16,000 tons for St. Louis nickel steel bridge.

17—Official announcement made that Powell Stackhouse, president of the Cambria Steel Co., will retire at next annual meeting and be succeeded by Charles S. Price, vice president and general manager. Pennsylvania railroad orders 10,000 steel cars.

20—Foundry iron shows some softness in Pittsburg territory.

21—American Bridge Co. awarded New York subway steel contract requiring about 35,000 tons.

22—Iron pipe advanced $2 a ton.

25—Republic Iron & Steel Co. buys 18,000 tons of Bessemer iron for first quarter shipment at $19 valley.

26—Wm. G. Mather and associates buy large block of Greene county, Pa., coking coal.

27—J. B. Finley elected president of Colonial Steel Co., Pittsburg.

28—Bar iron weakens in western markets owing to softer scrap market.

29—Basic Steel Co. announces plan to erect new open-hearth plant at Niles, O.

30—Port Henry, N. Y., ore prices for 1910 announced at average advances of 40 cents a ton.

### December.

1—First blast furnace of new Aliquippa group of Jones & Laughlin Steel Co. is blown in.

2—November selling of Bessemer pig iron in Pittsburg and valley territory announced as 69,300 tons at average price of $19 valley.

4—American Sheet & Tin Plate Co. attempts to resume operations at Aetna-Standard works, Bridgeport, O., rioting results and troops are called out. Sixth furnace at Gary blown in.

5—William Metcalf, president of Braeburn Steel Co., Braeburn, Pa., dies.

6—Republic Iron & Steel Co. awards contracts for new blast furnace at Haselton, O.

7—George Westinghouse elected president of the American Society of Mechanical Engineers.

9—Lake ore shipments up to Dec. 1 announced as 41,164,359 tons.

11—American Steel & Wire Co. announces advance of $1 a ton in wire products.

10—Sheet bar market settles upon a $29 mill basis.

14—Republic Iron & Steel Co. awards contracts for new open-hearth billet and sheet bar mill construction at Lansingville, O.

15—American Sheet & Tin Plate Co. officially announces it will proceed at once with the expenditure of $4,500,000 for the construction of tin plate and sheet mills at Gary, Ind.

16—Deadlock over prices develops between coke operators and furnaces which have uncovered requirements. Lewis Peckitt elected president of the Eastern Pig Iron Association.

18—Manufacturers of nuts advance prices $2 a ton. Bolts are unchanged. Two big coking coal deals involving West Virginia and Greene county, Pa., coal lands announced at Pittsburg.

20—Cambria Steel Co. officially announces its purpose to enter the field of manufacturing wire products.

21—Sales of Superior Bessemer ore for season of 1910 fix prices at 50 cents advance.

22—Increased softness noted in the spot furnace coke market.

23—Purchase of additional block of 7,500 acres of West Virginia coking coal by Jamison Coal & Coke Co. Pittsburg is announced.

24—American Steel & Wire Co. announces intention to erect new blast furnace at Central plant Cleveland.

26—James W. Friend, president of the Clinton Iron & Steel Co. and vice president of the Pressed Steel Car Co. dies at Pittsburg.

27—Rogers-Brown Iron Co. of Buffalo organized to erect two additional blast furnaces at Buffalo.

28—Superior non-Bessemer ore prices fixed at 50 cents advance by large sales.

29—National Tube Co. announces new classification of wrought pipe. Iron pipe makers adopt similar reclassification.

30—Frank B. Smith, president of the Crucible Steel Co. of America, dies at Pittsburg.

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The Lackawanna Steel Co. is planning to blow in its No. 3 stack at Buffalo within a day or so.

## BESSEMER ASSOCIATION ENTERTAINS CUSTOMERS.

The executive committee of the Bessemer Association, which is the selling agency in the valleys for Bessemer and basic pig iron, and the statistical bureau which collects a large amount of valuable information, gave a dinner at the Union Club, Cleveland, Dec. 29, to its customers. The members of the executive committee are: Samuel Mather, Edward L. Ford, Robert Bentley, Harvey H. Brown, Frank B. Richards, J. G. Butler Jr. Mr. Butler acted as toastmaster, and the following toasts were responded to: "Co-operation Versus Independent Action," J. A. Campbell, president, Youngstown Sheet & Tube Co.; "Night Thoughts," W. B. Palmer, president, American Steel & Wire Co.; "Business and the Law," Col. James H. Hoyt, Cleveland.

## WEST STEEL CASTING CO.

The West Steel Casting Co., Cleveland, having lately enlarged its plant and installed crucible furnaces to work in connection with its converter, took off the first heat from the crucible furnaces last Thursday. The company makes a specialty of medium and light weight steel castings. Aside from the general trade, such castings are used for dynamo and other electrical purposes, being formed with "West's electrical steel," made with alloys from converter metal. A line of auto and light castings are made from the crucible metal. The officers of the company are: President, Ralph H. West, son of Thomas D. West; vice president, Everett W. Pike; secretary, D. P. Lansdowne.

## ADDING TO ITS EQUIPMENT.

The Ohio Seamless Tube Co., Shelby, O., which placed its plant in operation last April, has been compelled to increase the capacity of its cold-drawn department about 50 per cent and to add other machinery equipment throughout the plant to care for increasing business.

## WILL INSTALL PIG CASTING MACHINE.

The Federal Furnace Co., Chicago, has placed a contract for a pig casting machine to be installed at the earliest date possible. This installation will place the furnace in position to furnish basic and other grades of machine cast pig iron.

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The Detroit Iron & Steel Co. relighted its furnace, Dec. 4.

## PERSONAL.

James M. Creamer was recently placed in charge of the publicity and advertising department of the International Steam Pump Co.

H. H. Ives, formerly with Henry A. Hitner's Sons Co., and well known in the Philadelphia scrap trade, is now connected with Chas. Drefus & Co.

A. C. Dinkey, president of the Carnegie Steel Co., has been made a member of the board of trustees of the Carnegie library, Pittsburg, succeeding Robert Pitcairn, deceased.

Herbert Du Puy, chairman of the board of the Crucible Steel Co. of America, has been elected president of the company, succeeding the late Frank B. Smith.

C. H. Brushaber, Hudson Terminal building, New York City, announces that he has become sales agent for the Osterburg Tin Plate Co., and the McKeesport Tin Plate Co., manufacturers of high grade black plate and tin plate.

David Coulter has resigned the office of secretary-treasurer of the Keystone Casting Co., Chester, Pa., which he has held since the organization of the company, several years ago.

Bertram D. Robinson, who for some time represented Nash, Isham & Co. on the road, will, on Jan. 1, become associated with B. Nicoll & Co., covering the territory south of New York.

M. L. Johnson, who has been in charge of the order department of the Sharon, Pa., plant of the American Steel Foundries, has been promoted to the position of assistant manager.

H. W. Jack, contracting manager for the American Bridge Co., at Seattle, has resigned and will be succeeded by C. C. Obermire, who has been connected with the Duluth office of this interest.

Donald McLeod, for nine years associated with the Merchants' National Bank, of Philadelphia, on Jan. 1 assumed his new duties as treasurer of the Jamison Coal & Coke Co., Pittsburg.

Walter Laidlaw, originally identified with the Laidlaw-Dunn-Gordon Co., Cincinnati, and general manager of the Snow Steam Pump Works, Buffalo, N. Y., is hereafter to be located at the New York office of the International Steam Pump Co.

George M. Brill and H. C. Gardner, Marquette building, Chicago, announce the formation of a partnership under the name of Brill & Gardner, to continue the engineering and architectural practice heretofore conducted by Mr. Brill. The firm will make a specialty of engineering and architectural problems.

M. H. March has become associated with Frank Samuel, Philadelphia, succeeding H. S. Matlack, who was in charge of the pig iron department. Mr. March was connected with Smith, Rudy & Co., metallurgists and foundry specialists, of Philadelphia.

S. B. Raney, for a number of years connected with the general offices of the Carnegie Steel Co., at Pittsburg, but for the past two years chief clerk at St. Louis district office of that company, has recently been promoted to the general offices of the Illinois Steel Co., at Chicago, as chief clerk of the general sales department.

J. L. HAINES.

J. L. Haines, heretofore manager of the order department of the Jones & Laughlin Steel Co., Pittsburg, has been made assistant to Willis King, vice president of the company. Mr. Haines is succeeded by Thomas Anderson, assistant manager of the order department.

J. D. Conway, formerly chief clerk in Pittsburg of the Pittsburg & Lake Erie motive power department, on Jan. 1 became secretary of the Railway Supply Manufacturers' Association. The headquarters of the association have been removed from Chicago to Pittsburg and established in the German National Bank building.

Samuel W. Emerson, engineer of construction of the City Building Department, Cleveland, has resigned and has become a member of the newly organized firm of Courtney & Emerson, successors to the Courtney Engineering Co., with offices in the American Trust building, Cleveland. The firm will continue its general line of engineering and architectural work.

A. H. Garrison and F. C. Porter have been appointed assistant secretaries for the United States Metal Trades Association of the Pacific Coast. Mr. Garrison will have charge of the Seattle office of the association, at 319 Pioneer building, and Mr. Porter is in charge of the central offices, now located in the Commercial Club building, Portland, Ore.

Michael J. Drummond, well known as a manufacturer of cast iron pipe, has been appointed commissioner of charities of New York City. Henry S. Thompson, who has been named as commissioner of water supply, gas and electricity, was one of the founders of the Thompson-Starrett Co., builders.

A. Burchard, of the firm of Burchard & Case, consultling engineers, Cuyahoga Building, Cleveland, has been appointed director of the mechanical section of the American Exposition, which will be held in Berlin, Germany, during June, July and August. A large number of American manufacturers have already reserved space, and many of the exhibits are now being placed. For the mechanical section an allotment of 15,000 square feet has been made, and reservations can be made and full particulars regarding the exposition can be obtained from Mr. Burchard.

## OBITUARY.

D. Ogden Mills, who died Jan. 4, was a director of Lackawanna Steel Co.

Edward S. Means, a resident of Bellevue, a suburb of Pittsburg, died Dec. 27, after an illness of nine weeks. For many years Mr. Means was connected with the Wayne Iron & Steel Co., now Brown & Co., of Pittsburg. He retired two years ago because of failing health.

## LIGHT INQUIRY.

Pittsburg, Jan. 5. (By wire.)

Pending foundry inquiry is for about 2,000 tons. A sale of 150 tons for first quarter was made at $17.25, valley, for No. 2.

The Delaware River Steel Co., Chester, Pa., expects to have its furnace in operation about Jan. 15. The stack, which formerly belonged to the Tidewater Steel Co., has been relined and thoroughly repaired.

The Platt Iron Works, Dayton, O., has taken out a building permit to erect a one-story building across three lots at Ohio and Webster streets, the building to be used for storing patterns.

# The Year in Financial Circles

The year 1909 in financial circles will long be remembered as a period of rapid recovery following a period of depression, ending in the complete restoration of prosperity. It was the year in which "new high records" were made with such frequency as to be monotonous and it merged into 1910 with the promise of continued activity.

The year on the stock exchange was one of advancing prices, a fact shown graphically on the adjoining page as to 13 industrial stocks. The average price of the 13 at the beginning of the year was approximately 87.7 and at the end 101.

Some of the big figures for the year follow: Money supply Dec. 1 $3,131,310,934, the highest ever reached; gold in the United States treasury, Nov. 6, $1,052,320,000, the highest in the history of the country; gold in outside circulation Feb. 1, $1,444,252,439, which just falls short of the highest record in May, 1908; national bank circulation, Dec. 1 $707,433,457, the highest on record; cash holdings by national banks June 23, $885,915,771, a figure which outstripped all previous records but was largely reduced by the demands of business before the end of the year. The loans by national banks reached their maximum Nov. 16 at $5,148,787,594. Bank clearings were lowest in February, but reflected the growth of business by rapid increases until in October they reached a total of $15,851,214,417. Between February and August, the sales of shares on the New York exchange doubled, being something over 12,000,000 in February and 24,537,840 in August. Bond sales failed to keep pace with the sales of shares and were short of the total of 1908 by $163,707,000.

Business failures during 1909 were frequent, but not so important or numerous as in the year before. For 11 months, the failures numbered 10,682, with liabilities of $128,435,870, against 12,756 failures in 1908 with liabilities of $275,261,863, and 8,969 in 1907, with liabilities of $307,227,939.

Money was easy during the greater part of the year and call money was obtainable in February at less than 2 per cent. The rate increased gradually during the year and touched 7 per cent in the last week in December.

In May, gold exports passed the $15,000,000 mark; the return of prosperity was heralded by a 10 per cent increase in wages affecting thousands of men in the Pittsburg district and Steel common was well on the way towards its spectacular rise, closing the month at 64¾. In June, stocks were irregular, opening strong with Union Pacific and Steel common for leaders; President Taft recommended the 2 per cent tax on the net income of corporations. July was a record-breaking month in stock prices. Steel common was put on a 3 per cent basis and government crop reports indicating a cotton shortage sent cotton prices higher. In August prices depended to a large degree upon conflicting reports as to the health of E. H. Harriman, but Steel common and Union Pacific continued to break records. Later in the month, Union Pacific dropped back upon the return of Mr. Harriman and his repudiation of the much discussed segregation scheme. Sept. 9, E. H. Harriman died and the next day stocks surprised the world by rising rapidly. In October, Steel common passed 90 and call money went to 6 per cent. Oct. 5 banks began curtailing loans and the Bank of England raised its rate to 5 per cent. The rate on Steel common was advanced to 4 per cent. In November trading was duller and prices lower.

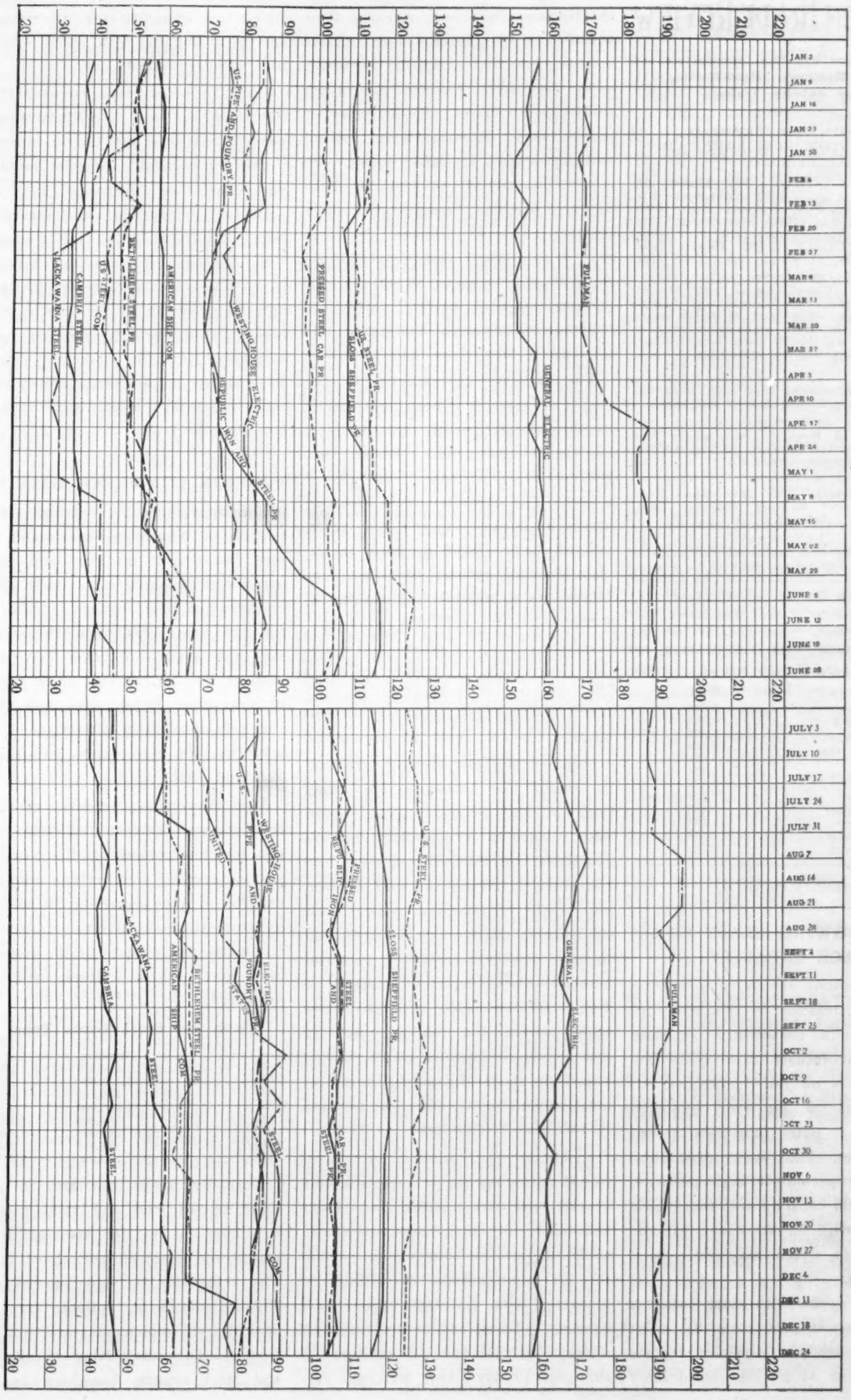
The Standard Oil decision was rendered and there was much discussion of the copper merger. In December, Louisville & Nashville and Reading advanced their dividend rate; sterling exchange rose to the gold export point and Rock Island made a sensational jump which resulted in an investigation.

## THE LEADING INDUSTRIAL SECURITIES.

| | Closing Dec. 31, 1908. | Closing Dec. 31, 1909. | Date 1909 Ann. M't g | Changes in 1908. | ‡At pres't price. | Basis. | Dividend Last Declared | Dividend Date Last Div. Pay. |
|---|---|---|---|---|---|---|---|---|
| Allis-Chalmers | 15¾ | 15¼ | Sept. 2 | — ½ | .... | | ..... | ..... |
| Allis-Chalmers, pr. | 49⅛ | 55 | | + 5⅞ | .... | 7 cum. | 1¾ Q. | Feb., 1904 |
| American Can | 9 | 13¾ | Feb. 2 | + 4¾ | .... | | ..... | ..... |
| American Can, pr. | 73⅜ | 81 | | + 7⅝ | 8.64 | 7 cum. | 1¼ Q. | Jan., 1910 |
| Am. Car & Fdy. | 50⅛ | 72½ | June 24 | +20⅜ | 4.00 | | ½ Q. | Jan., 1910 |
| Am. Car & Fdy., pr. | 109 | 120 | | +11 | 4.17 | 7 n. c. | 1¾ Q. | Jan., 1910 |
| American Loc. | 57¾ | 61¾ | Oct. 19 | + 4 | .... | 5 | 1¾ Q. | Aug., 1908 |
| American Loc., pr. | 113 | 115 | | + 2 | 6.09 | 7 cum. | 1¾ Q. | Jan., 1910 |
| American Ship | 57 | 78 | Oct. 13 | +21 | 5.13 | 4 | 1 Q. | Dec., 1909 |
| American Ship, pr. | 105½ | 111½ | | + 6 | 6.31 | 7 cum. | 1¾ Q. | Sept., 1909 |
| Am. Steel Foundries(new) | 39⅜ | 65 | Dec. 2 | +25⅝ | .... | | 1¾ Q. | ..... |
| Barney & Smith | 40 | 40 | June 1 | .... | .... | 4 | ..... | Sept., 1907 |
| Barney & Smith, pr. | 110 | 115 | | + 5 | .... | 8 cum. | 1 Q. | June, 1908 |
| Bethlehem Steel | 24½ | 34 | April 6 | + 9½ | .... | | ..... | ..... |
| Bethlehem Steel, pr. | 54⅞ | 66 | | +11⅛ | .... | 7 n. c. | ¾ Q. | Feb., 1907 |
| Cambria Steel | 39⅝ | 49 | Mar. 16 | + 9⅜ | .... | 3 | ¾ Q. | Aug., 1909 |
| Cambria Iron | 46½ | 47 | | + ½ | .... | 4 | 2 S. A. | Sept., 1909 |
| Chicago Pneumatic Tool | 27½ | 39½ | Feb. 15 | +12 | .... | 4 | 2 S. A. | Oct., 1907 |
| Colorado Fuel | 40 | 49⅜ | Oct. 18 | + 9⅜ | .... | | 1¾ Q. | April, 1902 |
| Crucible Steel | 8 | 18¾ | Oct. 20 | +10¾ | .... | | 3½ | ..... |
| Crucible Steel, pr. | 57½ | 93⅝ | | +36⅛ | 7.45 | 7 cum. | 1¾ Q. | Dec., 1909 |
| Empire Steel | 6 | 15 | April 27 | + 9 | .... | | ..... | ..... |
| Empire Steel, pr. | 47 | 80 | | +33 | 7.50 | 6 cum | 3 S. A. | July, 1909 |
| Fay & Egan | 90 | 95 | Feb. 18 | + 5 | .... | 7 | 3 S. A. | Nov., 1908 |
| Fay & Egan, pr. | 100 | 120 | | +20 | 5.83 | 7 cum | 1¾ Q. | Nov., 1909 |
| General Electric | 158 | 159½ | May 11 | + 1½ | 5.00 | 8 | 2 Q. | Jan., 1910 |
| Harbison-Walker | 17⅛ | 35 | Jan. 18 | +17⅞ | .... | | 2 Q. | Oct., 1907 |
| Harbison-Walker, pr. | 80 | 94½ | | +14½ | 6.38 | 6 cum. | 1½ | Oct., 1909 |
| International Pump | 39½ | 52¾ | June 8 | +13⅛ | .... | | 1 Q. | April, 1905 |
| International Pump, pr. | 84 | 90¼ | | + 6¼ | 6.67 | 6 cum. | 1½ Q. | Nov., 1909 |
| Lackawanna Steel | 47 | 64 | Mar. 10 | +17 | .... | | ..... | ..... |
| Lake Sup. Corp. | 16 | 28⅛ | Oct. 6 | +12⅛ | .... | | ..... | ..... |
| New York Air Brake | 93 | 95½ | June 17 | + 2½ | .... | 8 | 2 Q. | Oct., 1907 |
| Niles-Bement-Pond | 97 | 104 | Feb. 3 | + 7 | 5.77 | 6 | 1½ Q. | Dec., 1909 |
| Niles-Bement-Pond, pr. | 100 | 104 | | + 4 | 5.77 | 6 cum. | 1½ Q. | Nov., 1909 |
| Otis Elevator Co. | 42 | 55 | Mar. 15 | +12 | 5.45 | 3 | 1½ S. A. | Oct., 1909 |
| Otis Elevator Co., pr. | 97 | 99 | | + 2 | 6.06 | 6 n. c. | 1½ Q. | Oct., 1909 |
| Pa. Steel | 50 | 65 | May 10 | +15 | .... | | ..... | ..... |
| Pa. Steel, pr. | 103½ | 115 | | +11½ | 6.80 | 7 n. c | 3½ S. A. | Nov., 1909 |
| Pittsburg Coal Co. | 14 | 27⅜ | Mar. 9 | +13⅜ | .... | | ..... | ..... |
| Pittsburg Coal Co., pr. | 49 | 84 | | +35 | .... | 7 cum. | 1¾ Q. | Jan., 1910 |
| Pressed Steel Car | 43⅝ | 51¾ | Feb. 17 | + 7¾ | .... | | 1 Q. | Aug., 1904 |
| Pressed Steel Car, pr. | 102 | 106 | | + 4 | 6.60 | 7 n. c. | 1¾ Q. | Nov., 1909 |
| Pullman | 171 | 193 | Nov. 10 | +22 | 4.14 | 8 | 2 Q. | Nov., 1909 |
| Railway Stl. Spring | 48 | 51⅞ | Mar. 4 | + 3⅞ | .... | 2 | 1 S. A. | Oct., 1908 |
| Railway Stl. Spring, pr. | 102½ | 106¾ | | + 4½ | 6.54 | 7 cum. | 1¾ Q. | Dec., 1909 |
| Rep. Iron & Steel | 25¾ | 46 | Oct. 20 | +20¼ | .... | | ..... | ..... |
| Rep. Iron & Steel, pr. | 86 | 104¼ | | +18¼ | 6.73 | 7 cum. | 1¾ Q. | Jan., 1910 |
| Sloss-Sheffield | 77½ | 87 | Mar. 10 | + 9½ | 5.75 | 5 | 2 Q. † | Nov., 1909 |
| Sloss-Sheffield, pr. | 110 | 117½ | | + 7½ | 5.98 | 7 n. c. | 1¾ Q. | Jan., 1910 |
| U. S. Pipe & Fdy. Co. | 29¼ | 32½ | June 23 | + 3¼ | .... | 2 | 1 Q. | Dec., 1907 |
| U. S. Pipe & Fdy., pr. | 75¾ | 84⅛ | | + 8⅜ | 8.33 | 7 n. c. | 1¾ Q. | Dec., 1909 |
| U. S. Steel | 53⅞ | 91 | April 19 | +37⅛ | 4.40 | 4 | 1 Q. | Sept., 1909 |
| U. S. Steel, pr. * | 113¼ | 125 | | +11¾ | 5.60 | 7 cum. | 1¾ Q. | Aug., 1909 |
| U. S. Steel, 5s | 103 | 105⅛ | | + 2⅛ | .... | 5 | ..... | ..... |
| Va. Iron, Coal & Coke | 62½ | 73⅞ | Sept. 21 | +11⅜ | .... | | ..... | ..... |
| Westinghouse Elec. | 84¾ | 83 | June 16 | — 1¾ | .... | | 1¾ Q. | Oct., 1909 |
| Westinghouse Air Brake | 110¾ | 148½ | Oct. 5 | +37¾ | 8.08 | | 4 Q. | Oct., 1909 |

Par value of shares, $100, except those starred (*), $50.
†Includes deferred dividend of ¼ of 1 per cent.
‡Return on investment.

# FLUCTUATIONS OF LEADING INDUSTRIAL STOCKS IN 1909.



# THE IRON TRADE REVIEW

**Devoted to Iron and Steel Manufacture and to the Machinery, Metal-Working and Foundry Trades.**

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THE AVERAGE PAID CIRCULATION OF THE IRON TRADE REVIEW FOR THE ISSUES OF THE FOLLOWING MONTHS WAS:

| | |
|---|---|
| January | 5,506 |
| February | 5,346 |
| March | 5,396 |
| April | 5,508 |
| May | 5,533 |
| June | 5,551 |
| July | 5,572 |
| August | 5,597 |
| September | 5,609 |
| October | 5,628 |
| November | 5,634 |
| December | 5,662 |

January 6, 1910


## OUR GROWING BLAST FURNACE CAPACITY.

The exhaustive review of new blast furnace construction in this issue indicates that a conservative estimate of the blast furnace capacity of the United States on Jan. 1, 1910, is 31,000,000 tons of pig iron annually. The figure is based, not upon recent performances, but upon production in the last period of high pressure, when the old capacity was thoroughly tried out, with an allowance for the new furnaces which have since been completed.

It is true that, with some furnaces idle, the recent production has been shown by our blast furnace reports to have been at a rate considerably exceeding 31,000,000 tons a year, but the furnaces have been working temporarily at an abnormal rate. October weather was excellent, as usual, while November weather was good, which is not usual. Furthermore, a great many furnaces were relined and otherwise repaired during the depression, and at present the condition of the blast furnaces as a whole is much above the normal. It is regarded as normal that about 10 per cent of the furnaces should be out for one cause or another, chiefly for relining; at present the total idle capacity is much less than this.

The increase in capacity in the past five years has been due chiefly to the completion of new furnaces, but the rebuilding and otherwise improving of old furnaces has played a part. The absolutely new furnaces, blown in during the past five years, and which are listed in detail in the blast furnace article, have been as follows as to number and annual capacity:

| Year. | Number. | Capacity. |
|---|---|---|
| 1905 | 10 | 1,292,000 |
| 1906 | 9 | 1,135,000 |
| 1907 | 15 | 2,065,000 |
| 1908 | 10 | 1,188,000 |
| 1909 | 12 | 1,930,000 |
| Total | 56 | 7,610,000 |

Capacity has not stopped growing, as many new furnaces are being built at the present time. Eight, with a capacity of 1,034,000 tons, are completed or nearly completed, and can come in during the first quarter, with two, 330,000 tons capacity, for the second quarter. It is important to note, however, that the performance of existing furnaces is likely to deteriorate somewhat through necessities arising for relining, etc., so that actual production, which of late has been above the actual rating, is not likely to show very great increase in the next few months.

Including the furnaces just mentioned as in line to become available in the next few months, and others scheduled for later completion, the total in line for blowing in within the first nine months of 1910 is 16 furnaces, with 2,219,000 tons annual capacity. These are in projects well under way already. In addition, in the past 10 days, two merchant furnace projects have been announced, embracing two furnaces at Chicago and two at Buffalo, with about 475,000 tons annual capacity.

With an actual capacity of 31,000,000 tons on Jan. 1, 1910, available year in and year out, the 16 furnaces to become available in nine months, with the four furnaces just announced, presumably for somewhat later completion, bring the country's total capacity in sight to 33,700,000 tons. The various figures seem large, but, as is shown in the article, they are fairly in line with the past performances of the industry, which has shown a doubling, time after time, at average intervals of slightly less than 10 years.

## FOREIGN COMMERCE GAINING.

The appearance of detailed statistics of the November import and export movement in iron and steel permits the making of a fairly close estimate of our foreign commerce for the year 1909, with the result that the exports of iron and steel tonnage lines in the year show a gain of more than 250,000 tons over 1908, and fall only about 100,000 tons below the two best years on record, 1906 and 1907.

The November exports of tonnage lines were substantially the largest for any month so far in the year, exceeding the average monthly exports of the preceding 10 months by more than 15,000 tons.

Imports and exports of the tonnage lines have been as follows, with 1909 estimated:

**Iron and Steel, Gross Tons.**

| | Imports. | Exports. |
|---|---|---|
| 1902 | 1,212,839 | 372,398 |
| 1903 | 1,178,996 | 326,590 |
| 1904 | 266,398 | 1,167,710 |
| 1905 | 416,000 | 1,010,255 |
| 1906 | 577,809 | 1,325,740 |
| 1907 | 662,358 | 1,302,525 |
| 1908 | 206,955 | 964,266 |
| 1909 | 360,000 | 1,225,000 |

Normally about one-third of the value of all iron and steel exports is comprised in the tonnage lines, which find place in the above table. The remainder is made up of machinery, hardware, cutlery, etc., but agricultural implements are not included. The total value of all iron and steel exports has been as fol-

lows, the 1909 total being estimated from returns for 11 months:

**Value of Iron and Steel Exports.**

| | |
|---|---|
| 1900 | $129,633,480 |
| 1901 | 102,534,575 |
| 1902 | 97,892,036 |
| 1903 | 99,035,865 |
| 1904 | 128,553,613 |
| 1905 | 142,928,513 |
| 1906 | 172,555,588 |
| 1907 | 197,066,781 |
| 1908 | 151,113,114 |
| 1909 | 157,000,000 |

The value of all iron and steel exports in November showed a gain of 20 per cent over the average value in the preceding 10 months. The November exports were at the rate of about $175,000,000 a year, auguring a fair average for 1910 as compared with previous years, since but one year, 1907, showed a higher total value than this.

The exports of tonnage lines in November were at the rate of 1,400,000 tons a year, or slightly better than any calendar year has yet shown.

Iron and steel imports in 1909 prove larger than would have been anticipated from the movement early in the year. There was a material gain, as the year progressed, in ferro manganese, spiegeleisen and ferrosilicon, while in November a considerable tonnage of ordinary pig iron began to appear. The monthly statistics do not segregate the ferroalloys from ordinary pig iron. The totals of all grades have been as follows:

| | |
|---|---|
| January to June | 58,901 |
| July | 17,899 |
| August | 10,422 |
| September | 12,601 |
| October | 11,851 |
| November | 34,707 |

The jump in November imports of pig iron was presaged in our issue of Dec. 23 last, it being noted that British exports of pig iron to the United States had jumped from an average of less than 10,000 tons a month, January to September inclusive, to 15,662 tons in October and 32,832 tons in November.

Our iron ore imports in 1909 broke all records. The lightest month was February, with 61,749 tons, the heaviest being August, with 209,855 tons. November imports were 174,976 tons. Allowing for a moderate decrease in December, the year's total should be about 1,640,000 tons, or nearly half a million tons in excess of the largest previous year. Iron ore imports, with 1909 estimated, have been as follows in the past seven years:

| | Gross tons. |
|---|---|
| 1903 | 980,440 |
| 1904 | 487,613 |
| 1905 | 845,651 |
| 1906 | 1,060,390 |
| 1907 | 1,229,168 |
| 1908 | 776,898 |
| 1909 | 1,640,000 |

## ANNUAL CHART

**Showing Price Fluctuations During the Past Fifteen Years.**

The chart which accompanies this issue as a supplement shows fluctuations in the prices of iron and steel products for the past 15 years. The figures on which the chart is based are the average weekly prices given in the market reports of THE IRON TRADE REVIEW. They are computed for the following:—Tank plates, Chicago; beams, Pittsburg; bar iron, Cleveland; Bessemer billets, Pittsburg; Bessemer pig iron, Pittsburg; No. 2 foundry, Chicago; gray forge, Cincinnati; No. 2 foundry, Birmingham. Last year a new line was added showing the prices of steel bars from 1897 to 1908, both inclusive, in response to a general demand for this information. The prices in accordance with the line for steel bars are given in the accompanying table.

The vertical lines in the chart represent months, and the horizontal lines the prices in dollars per net ton in the case of finished material, and per gross ton in the case of pig iron and steel billets. The solid and broken lines traversing the diagram indicate the changes in the monthly average prices, but do not, of course, show the extreme high or extreme low prices which may have been reached in some week of the month. In the case of pig iron, the minimum quotations for prompt delivery are taken.

The chart shows the short-lived boom of 1895, which followed a period of depression; then the decline in the latter part of 1895, followed by the slow general decline of 1896 and 1897, when in midsummer the lowest prices on record prevailed; a rather steady trend of prices from the middle of 1897 until the fall of 1898; the rapid rise at the close of 1898 followed by the very high quotations of the boom year, 1899; sharp decline in 1900, and a partial recovery at the close of the year; a continuance of prices upward during 1901; a rapid advance during the first half of 1902; a sharp decline beginning the fall of 1902 and continuing during 1903, followed by a long period of prosperity, ending in October, 1907, although there were some price recessions earlier in 1907.

The effect of the price maintenance policy is shown in 1908 by the fact that prices were more regular than they would have been without it, but with the declaration of the open market in 1909 the chart shows a dip in the lines and a gradual recovery from the middle of the year, but the high prices attained in other years of prosperity were not reached in 1909. The year 1909 closed with prices on a number of products about the same as they were at the beginning of the year.

A few extra copies of the chart have been published and will be sent in tubes to subscribers who request them for framing. The charts are the same size as those of last year and will fit into the old frames.

## WILL BUILD BRIDGES.

The Hunter Iron Works Co., Inc., Atlantic, Ia., advises respecting its recent incorporation that it purposes to fabricate and construct highway bridges. At the next meeting of the stockholders, S. G. Hunter will transfer his interest in the business to the new company, and will retire from connection with it. Among the principal stockholders of the new company are: R. Z. Drake, of Omaha; Pierce Metz, of Atlantic, Ia.; and Hugo Hoenig, of Red Oak, Ia. It is understood that the new company contemplates enlarging the present building, and adding some new machinery,—such equipment as a friction saw, bulldozer, etc. Mr. Hunter plans to engage in the iron business in some other locality.

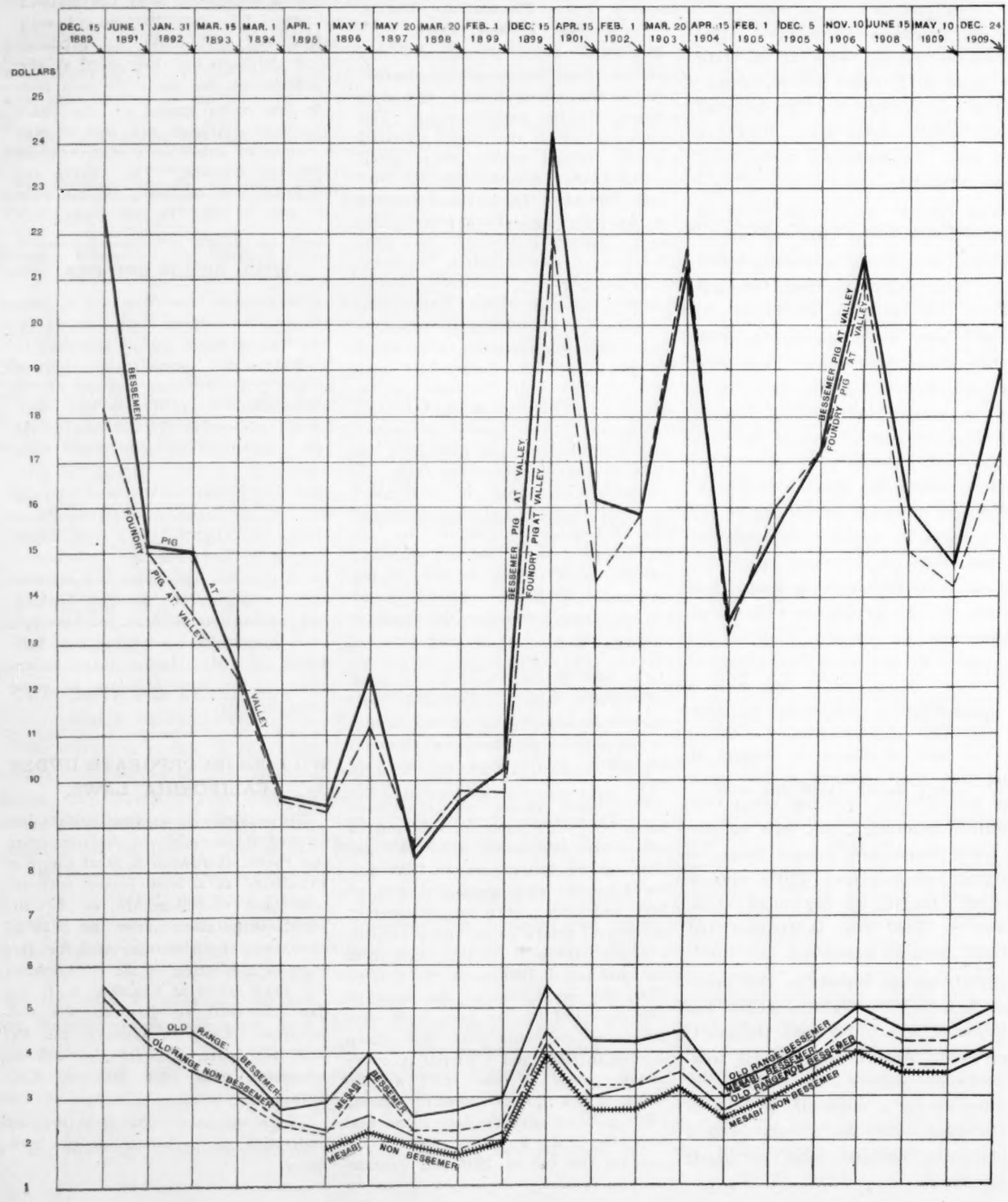
## WILL RE-INCORPORATE UNDER CALIFORNIA LAWS.

The majority of its stockholders has deemed it advisable to disincorporate the Pacific Hardware & Steel Co., San Francisco, as a New Jersey corporation, and re-incorporate as a California corporation under the laws of the state of California; and for this purpose a meeting of the stockholders has been called at Camden, N. J., for Jan. 17, 1910, to dissolve this corporation. Early in January, the Pacific Hardware & Steel Co. will incorporate under the laws of California.

There will be no change in the capitalization or personnel of the company.

# PRICES OF PIG IRON AND IRON ORE FOR 21 YEARS

The accompanying chart shows the prices at which iron ore has sold during the 20 years beginning Dec. 15, 1889, together with the prevailing valley prices of Bessemer and No. 2 foundry pig iron at the date at which the ore buying movement was at its height. The buying season for 1907, a year of great prosperity, was the earliest on record. The most active point of the market was about Nov. 10, 1906. Within a week, practically all of the ore was sold. Next to the early buying movement of the year 1907 come the years 1906, with Dec. 5, 1905, as the date of the buying movement, and 1890 and 1900, each with Dec. 15 of the pevious years, as the date of tthe height of the buying movements. The year 1905 was notable for two buying movements, one for the supply of ore for that year, which began Feb. 1, and the second for the requirements of 1906, which began Dec. 5. In February, 1908, owing to the influence of the United States Steel Corporation and the wishes of some buyers, the 1907 prices were reaffirmed for 1908 at a meeting held in Cleve-



land, and, at the same time, the pig iron manufacturers held a meeting at which it was decided to endeavor to maintain a basis of $17, valley, for No. 2 foundry iron. The market continued to drag, however, and on June 15, ore prices were reduced 50 cents. The buying movement then started, being the latest on record. Last year, many reservations were made during the early months, and there was a little actual buying, but prices were not really determined until May 10.

This year, all the Bessemer ore available was reserved before the price was established and reservations were quickly changed into actual sales. Some non-Bessemer ore has also been sold, but a large tonnage is still to be disposed of.

It should be noted that the basic guarantee of iron content was changed in November, 1906, when on both old range and Mesabi Bessemer, the natural iron content guarantee was reduced from 56.70 to 55 per cent, and on both old range and Mesabi non-Bessemer from 52.80 per cent to 51.50 per cent. On the old basing schedule, the prices for 1907, 1908, 1909 and 1910 would be about 17 cents higher on Bessemer and 11 cents higher on non-Bessemer grades.

The idea, which was first embodied in chart form in our issue of Feb. 21, 1907, is to establish in a graphic manner the relation of the raw material price to that of pig iron. During the past years up to 1909, barring some slight irregularities, the two series of lines have approached nearly to being parallel, showing that ore prices have declined with the prices of iron. Last year, while the lines representing pig iron prices had a downward tendency, those for iron ore prices continued straight.

THE IRON TRADE REVIEW of May 20, said:

"While it is true that pig iron prices are lower than they were when the ore prices for 1908 were fixed, it is also true that present conditions are more favorable than at any time since the panic of 1907. Because it is confidently believed that the pig iron which will be made from the new ore will sell at higher prices than now prevail, and also because many blast furnace owners were opposed to lowering ore prices, the ore interests felt justified in reaffirming last year's prices."

The history of the past year has justified the action of the ore interests. This year, the lines showing pig iron prices and also ore prices have an upward tendency, but it is also true that in November, 1906, when the prices for 1907, now reestablished, were made, both Bessemer and No. 2 foundry pig iron were selling at $21.50, valley, compared with $19 and $17.25, respectively, at the present time.

SELLING PRICE OF IRON ORE AND PRICE OF PIG IRON AT DATE OF BUYING MOVEMENT.

| Season. | Date Buying Movement. | Season Iron Ore Prices. O. R. Bess. | Mes. Bes. | O. R. non-B. | Mes. non-B. | Iron Prices, Valley. Bess. | No. 2 Fdy. |
|---|---|---|---|---|---|---|---|
| 1890 | Dec. 15 '89 | $5.50 | no sale | $5.25 | no sale | $22.15 | $18.15 |
| 1891 | June 1, '91 | 4.50 | no sale | 4.25 | no sale | 15.15 | 15.00 |
| 1892 | Jan. 31, '92 | 4.50 | no sale | 3.65 | no sale | 15.00 | 13.65 |
| 1893 | March 15, '93 | 3.85 | $3.00 | 3.20 | no sale | 12.65 | 12.15 |
| 1894 | March 1, '94 | 2.75 | 2.35 | 2.50 | no sale | 9.65 | 9.65 |
| 1895 | April 1, '95 | 2.90 | 2.15 | 2.25 | $1.90 | 9.40 | 9.40 |
| 1896 | May 1, '96 | 4.00 | 3.50 | 2.70 | 2.25 | 12.40 | 11.15 |
| 1897 | May 20, '97 | 2.60 | 2.25 | 2.15 | 1.90 | 8.35 | 8.40 |
| 1898 | March 20, '98 | 2.75 | 2.25 | 1.85 | 1.75 | 9.55 | 9.80 |
| 1899 | Feb. 1, '99 | 3.00 | 2.40 | 2.15 | 2.00 | 10.30 | 9.75 |
| 1900 | Dec. 15, '99 | 5.50 | 4.50 | 4.25 | 4.00 | 24.15 | 22.15 |
| 1901 | April 15, '01 | 4.25 | 3.25 | 3.00 | 2.75 | 16.15 | 14.40 |
| 1902 | Feb. 1, '02 | 4.25 | 3.25 | 3.25 | 2.75 | 15.90 | 15.90 |
| 1903 | March 20, '03 | 4.50 | 4.00 | 3.60 | 3.20 | 21.50 | 21.65 |
| 1904 | April 15, '04 | 3.25 | 3.00 | 2.75 | 2.50 | 13.35 | 13.15 |
| 1905 | Feb. 1, '05 | 3.75 | 3.50 | 3.20 | 3.00 | 15 50 | 16.00 |
| 1906 | Dec. 5, '05 | 4.25 | 4.00 | 3.70 | 3.50 | 17,25 | 17.25 |
| 1907 | Nov. 10, '06 | 5.00 | 4.75 | 4.20 | 4.00 | 21.50 | 21.50 |
| 1908 | June 15 | 4.50 | 4.25 | 3.70 | 3.50 | 16.00 | 15.00 |
| 1909 | May 10 | 4.50 | 4.25 | 3.70 | 3.50 | 14.75 | 14.25 |
| 1910 | Dec. 24, '09 | 5.00 | 4.75 | 4.20 | 4.00 | 19.00 | 17.25 |

## MICHIGAN PORTS

### Are Growing in Importance as Receivers of Ore.

The growing importance of Lake Michigan's Lake Superior ore receiving ports is proved by the receipts of 1909 when 6,929,831 tons were received. A few years ago the ore receipts at Lake Michigan ports were insignificant, but during the past three years the development of steel plants along the southern shore of Lake Michigan has been rapid. Following are the receipts by ports:

| | |
|---|---|
| South Chicago, Ill. | 4,673,810 |
| Milwaukee, Wis. | 178,720 |
| Gary, Ind. | 1,921,818 |
| East Jordan, Mich. | 18,623 |
| Boyne City, Mich. | 37,062 |
| Elk Rapids, Mich. | 46,037 |
| Fruitport, Mich. | 53,761 |
| Total | 6,929,831 |

It is announced from Buffalo that Congressman Alexander will ask for an appropriation for the survey of a fourth lock on the American side at Sault Ste. Marie. Work is now under way on a third lock to be approximately 1,350 ft. long, but it is believed that by the time it is finished a fourth lock will be urgent. In fact, this has been the history of the locks at the Sault; the Poe lock was no sooner finished than it proved inadequate. For while it was designed forever to lock through four vessels at a time, yet, before it was completed it was seen that it could lock through only two and now it can lock through only one of the larger type of carrier at a time.

There is a marked demand for coal in the northwest and shipments from docks to the interior are heavy, notwithstanding the weather. It is predicted that the docks will be practically clean when navigation opens, and that the coal movement next year will be correspondingly heavy.

## FURNACE ORDERED SOLD.

Ironton, O., Jan. 1.

On an action by Louis F. Feiser and Linn Bentley, partners as Feiser & Bentley, of Columbus, O., against the Bird Iron Co., Judge Blair in common pleas court yesterday evening issued an order of sale for the company's property by Capt. H. R. Brown, receiver. The sale will be held at the court house in this city at 2 p. m., Friday, Jan. 14. The property consists of the blast furnace at Colbertson, this county, 392 acres of mineral lands adjacent thereto, commissary and stock on hand. The furnace will be offered together with real estate and separately. All bidders shall deposit a certified check for $5,000. The appraisement is $89,390 for real estate and $5,560.15 for personal property, a total of $94,950.15, and bids must be for two-thirds of appraised value. It is understood that a number of southern Ohio iron interests will be bidders.

## COMPLETING ITS SLAB MILL.

The Forged Steel Wheel Co., Butler, Pa., is exerting every effort to complete its proposed steel slab mill by the middle of February. It may be, however, that its six open-hearth furnaces will not be ready for lighting until March 1. While the company has a large supply of slabs on hand, yet at the present rate of consumption the supply may be exhausted by March 1. Hence the rush to complete the raw steel department.

**The Keystone furnace of the Reading Iron Co. has been blown out, not having worked well after extensive repairs had been made.**

# AMONG MACHINERY MAKERS.

## CINCINNATI.

### Higher Prices May Become the Rule Among Machinery Builders.

Office of THE IRON TRADE REVIEW,
First National Bank Bldg., Jan. 4

The last month of the year, in spite of the holiday season, has been productive of such a satisfactory run of orders and the shops in some instances are so behind on deliveries that the New Year begins under the most favorable auspices. The shops in this center are for the most part running full time and with as full force as they can obtain of satisfactory workmen. Some of the smaller plants are busy with inventories. The close of the year is bringing out the question on the part of the manufacturer as to whether production at present is as great per operative as during 1907. It is asserted by some that the production is less per operative than in that year, due to the fact that the depression in business early in 1909 has compelled the manufacturer to acquire a new working force and build up a comparatively new organization and the machine tool manufacturer has been forced to compete with the automobile maker for the highest class of workmen. These elements are increasing cost of manufacture and it seems apparent that prices of machine tools must be advanced in 1910, this being due to the higher scale of wages, the lessened output per operative, and the higher cost of materials. Unless prices are advanced the margin of profit must of necessity be reduced. Some manufacturers of special machines have already advanced prices, but what may be done in reference to the standard machines is not yet apparent.

During the past year, especially in the last half of the year, the shops have added to their equipment steadily and plans are under way for the enlargement of some of the shops and the building of some new ones, the manufacturers having outgrown the smaller quarters. There is ample evidence that Cincinnati as a machine tool manufacturing center is increasing in importance and continues to occupy a most prominent place in the country for specialization in this industry.

The Acme Machine Tool Co., manufacturing screw machines and turret lathes, has advanced prices about 10 per cent on all of its machines. Preparations are under way for this company to gradually occupy the plant of the Cincinnati Planer Co. on Buck street, while the Cincinnati Planer Co. will gradually move to its new plant in the factory colony at Oakley. The Acme Machine Tool Co. has placed orders for a large portion of new equipment. Among the orders given are: Three Cincinnati milling machines, two Bickford radials, several makes of lathes, a Norton grinding machine, one keyseater, and one horizontal boring and drilling machine. The business of the company is growing beyond expectations and deliveries are getting farther in arrears. The Cincinnati Planer Co. reports that December, 1909, in point of orders was the biggest month in the history of the concern.

The Schumacher & Boye Co. is sending out another of its attractive calendars consisting of 12 sheets, one for each month and each sheet showing a picture of one of its lathes, the calendar thus becoming practically a catalog. An excellent business is reported by the company and the outlook for 1910 is regarded as exceedingly bright.

Greaves, Clusman & Co. regard conditions as satisfactory and are anticipating an excellent business in 1910.

The Cincinnati Lathe & Tool Co. received a large number of orders in December and the rate at which business is keeping up furnishes a splendid prospect for the new year.

The Hisey-Wolf Machine Tool Co. reports an excellent demand for portable drills and small machines of this character.

## BUFFALO.

### Outlook for 1910 is Very Promising to Buffalo Dealers.

Office of THE IRON TRADE REVIEW,
932 Ellicott Square, Jan. 4.

The machinery makers and dealers generally are gratified with the outlook for 1910 and look back upon the closing months of this year with a great deal more satisfaction than they had looked forward earlier in the year. Nearly all lines are enjoying a liberal amount of business and specifications on the heavier tools are coming out freely. The demand for heavy machinery is increasing at this point.

Walter Laidlaw, general manager of the Snow Steam Pump Works, Buffalo, who has been transferred to the New York office of the International Steam Pump Co., will assume his new duties Jan. 15. Mr. Laidlaw came here from Cincinnati. A. Niedermeyer of New York will succeed Mr. Laidlaw as general manager of the Snow works. A banquet will be tendered Mr. Laidlaw by the staff of the local plant before his departure for New York.

The annual banquet of the officials, department chiefs and foremen of the Pratt & Letchworth Co., was held today at the Iroquois Hotel. Staffs of the Buffalo, New York and Brantford, Ont., plants were present, also those of the United States Hame Co. The program was elaborate. O. P. Letchworth is president of the Pratt & Letchworth Co.

The Rogers-Brown Iron Co., organized to take over the Buffalo & Susquehanna Iron Co. of Buffalo, and to build two additional blast furnaces, will equip them with pig casting machinery. The general plan for construction and mechanical equipment contemplates duplicating the plant now operated at South Buffalo by the Buffalo & Susquehanna Iron Co.

Permission has been granted to the Utica & Southern Railroad Co., to build an electric road from Clinton to Hamilton with branches to Deansboro and Waterville, N. Y. Extensive building of electric railways along the Canadian Niagara frontier is practically assured and will begin early in the spring. The principal interest concerned is the Niagara Falls, Welland & Dunnville Electric Railroad.

## NEW YORK.

### New Business Coming Out, Substantial Buying Being in Prospect.

Office of THE IRON TRADE REVIEW,
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With some of the largest factors in the machine tool trade of this district, December bookings were the heaviest of any month of the year, and with practically all interests business during the closing month held up to a far better extent than was anticipated. The final week developed some unexpected orders, with indications that early in 1910 some extensive lists will be put out. Buying during the recent months has been made up chiefly of scattered pieces of equipment, and the purchases of the General Electric Co. for its Schenectady works were of

this class. As to railway and industrial companies, it has been impossible in most cases to get through appropriations for additional machinery and equipment, when operations were not up to normal: the indications now are that, with operations well up to capacity, shops crowded and orders accumulating, conditions are ripe for buying of a more substantial character. Deliveries continue to grow more remote in the more active lines, and the current demand for early shipment is indicated by the fact that one local house, which recently had forty machines of a certain type in stock, has not only cleared these out but is now booked three months ahead. No further instances of price-advance are noted, but dealers are on the lookout for several early in the month.

The New York Central has not yet sent out lists of its requirements for West Albany, but this is under preparation and may appear at any time, involving an important lot of tools. Some purchasing for the Altoona plant of the Pennsylvania Railroad is also anticipated in the early future.

The International Steam Pump Co., which for some time has been an important contributor to the machine tool trade of this district, promises to continue in the market for a considerable time, as its appropriations for improvements and extensions at its various plants have been extremely large. For its Harrison works a large lot of foundry equipment will be purchased early in the year, as contracts for the building have already been let. The most important addition at this place is in the molding machine department, designed to increase the present foundry capacity about 50 per cent. For the Cincinnati works appropriations have been made for large foundry and machine shop buildings with equipment, additional boiler capacity and a new pattern storage house. Cranes and other equipment will also be purchased shortly for the Blake & Knowles works. The Northern Engineering Co. recently secured contracts for a number of cranes to equip the foundry and machine shop addition at the Deane plant and the pipe and thread cutting additions at the Snow works. A number of large Niles boring mills were recently purchased for the Worthington plant and several other makers shared in the placing of orders for smaller machine tools. The trade is expecting substantial orders for equipment in connection with the extension of the Power & Mining Machinery Co. plant at Cudahy, Wis.

Three additional barge canal contracts were awarded during the week. The Penn Bridge Co., Beaver Falls, Pa., will construct a number of lock, guard and sluice gates at a total of $199,640. Scott Bros., Baldwinsville, N. Y., will construct about seven miles of canal in Oneida county at a cost to the state of $1,748,679, and Shanley Morrissey, Inc., will dredge the Hudson for four miles above Waterford at its bid of $779,636. The last named is a New York concern.

## MILWAUKEE.

### Cutler-Hammer Co. Builds Branch in New York—Machinery Notes.

Milwaukee, Wis., Jan. 3.

The Cutler-Hammer Mfg. Co., of Milwaukee, has found it necessary to establish a branch factory in New York. It has just taken occupancy of its new factory in the Bronx borough, facing on Southern boulevard, 144th street and Timpson place. The building is 5 stories, of brick and steel, with 100,000 square feet of floor space. It was erected by the Worden-Allen Co. of Milwaukee, which has established offices in Chicago and New York. The Cutler-Hammer company has increased its capital stock from $1,000,000 to $1,800,000.

The Sivyer Steel Casting Co. of Milwaukee, has been obliged to defer its foundry construction work by cold weather, but by the first of April operations will be well under way and rushed to completion. Willis Collins, for 14 years with Allis-Chalmers Co., has been elected secretary and will be in charge of manufacturing, relieving Frederick L. Sivyer, president of the company, in these duties. Mr. Messenger, who has been secretary, has become vice president and manager in charge of sales. William C. Frye will continue treasurer.

The Allis-Chalmers Co. has received contracts for furnishing motor drive equipment for various automobile factories in Michigan. The Everett-Metzger-Flanders Co. of Detroit; Oak Park Power Co., of Flint, a subsidiary of the General Motors Co.; the Weston-Mott Co., of Flint; the Kelsey-Herbert Wheel Co., of Detroit; Rapid Motor Vehicle Co., of Pontiac; American Motor Castings Co. and Brush Runabout Co., of Detroit, have adopted the idea of electric drive, with Allis-Chalmers equipment. Contracts have been placed with the Allis-Chalmers Co. for the new municipal waterworks pumping station at Spokane, Wash. The equipment will consist of six single-suction, horizontal shaft, two-stage centrifugal pumps driven by three 900 horsepower induction motors, with a three-panel switchboard.

Several machinery builders in Wisconsin recently engaged in the manufacture of automobile trucks. The Schaefer Co. of Berlin, is building a truck designed by A. W. Wyman of Oshkosh, who also designed the gasoline locomotive for quarries and a washing machine, castings for which are made by the Schaefer foundry. The Weyher Co., of Whitewater, has started a production of 500 to 1,000 light delivery motor trucks for Fulton & Zinke of Chicago. The Dean Mfg. Co.'s foundry and machine shops at Seymour, have been taken over by a syndicate of local capital which will build automobiles and trucks.

William C. Callender of Minneapolis has been elected general manager of the Smally Mfg. Co. of Manitowoc, Wis., implement manufacturers. The interests of John G. and Timothy Kelley, who have been in charge of the plant, have been purchased by Mrs. C. F. Smalley and the heaviest stockholders. Nelson Winningstedt has retired as superintendent.

Stephen Bull, only surviving member of the company which founded the great Case works at Racine, Wis., received Christmas and New Year's greetings from the 1,200 employes in the form of a bouquet of American Beauty roses with cards signed by every employe and officer.

The Wisconsin Engine Co., of Corliss, is making room for the Corliss Motor Co., incorporated for $1,000,000 to build automobiles, until the new concern can build its own plant on a 10-acre tract adjoining the engine works. The equipment, patterns, etc. of the Owen Thomas Motor Car Co., of Janesville, Wis., which sold out to the Corliss company, are being transferred to Corliss. The engine works are to be operated at greatest capacity and probably night shifts will be put on at once.

The Fort Wayne Auto Axle Co., Fort Wayne, Ind., is steadily equipping its plant at Bloomingdale. So much machinery has been installed that it is expected the plant will be operating Jan. 15. The general manager of the company is J. R. Keenan.

## TWO BLAST FURNACES

### Will Be Added to Iroquois Iron Co.'s Plant at Chicago.

For the purpose of extending its business the Iroquois Iron Co., with blast furnaces located at South Chicago, on the Calumet river, has increased its capital, all paid in, to $3,000,000, and has financed a bond issue of an equal amount.

As a first step toward extensions, the company will immediately begin to construct two modern blast furnaces, with all the appurtenances thereto, on its property at the mouth of the Calumet river, with a capacity of approximately 700 tons of pig iron daily. This added to its present capacity, two furnaces, will make an output of 1,200 tons daily.

The new plant is estimated to cost at least $2,000,000, and when completed—in connection with the present plant—will give employment to 1,000 men. In addition to approximately 50 acres of land at and near the mouth of the Calumet river, the company has large holdings in iron mines in Minnesota and Michigan, which it is proposed to develop more fully.

The Iroquois Iron Co. is affiliated with the well known firm of Rogers, Brown & Co., dealers in pig iron, and has offices with Rogers, Brown & Co., in the Corn Exchange Bank building. The officers of the Iroquois Iron Co. are: M. Cochrane Armour, president; Wm. A. Rogers, of Buffalo, first vice president; E. L. Billingslea, second vice president; Geo. A. Tripp, treasurer; Chas. A. Stillman, assistant treasurer; S. A. Kennedy, general manager.

The directors include the above named together with D. B. Meacham and D. B. Gamble, of Cincinnati.

## PENNSYLVANIA TIN PLATE OUTPUT REACHES HIGH MARK.

Tin and terne plate production in the state of Pennsylvania during the year 1908 reached 649,040,248 pounds, as compared with 590,245,264 pounds in 1907, according to a special report completed by the state bureau of industrial reports. The total tin and terne plate production in the United States was 537,087 gross tons in 1908 and 514,775 gross tons in 1907. Lawrence county, in which are located the large Shenango and New Castle mills of the American Sheet & Tin Plate Co., led in the total output with 225,249,123 pounds, or 34.7 per cent. Westmoreland county was second with 214,717,223 pounds, or 32 per cent, and Allegheny county third, with 76,850,767 pounds or 11.8 per cent. In 1908, the tin plate industry in Pennsylvania was constituted of 19 plants with 166 hot mills and 168 cold mills, and the investment represented was $9,835,222 The number of persons employed was 8,263, and the value of the year's product $23,747,606.

## ORE MINING

### Will be Pushed in Dutchess County, N. Y., by Two Recently Organized Companies.

Through the recent organization of two companies, ore developments in Dutchess county, N. Y., are to be pushed on what are known as the Kelly and the Dover furnace properties. This section is included in the Salisbury region, the name applied to a limited territory in the northwest corner of Connecticut and the eastern portion of Dutchess county, near Poughkeepsie, N. Y. The ore from this district has been used for fully 150 years and is a brown hematite averaging about 50 per cent iron. Salisbury ore has been largely employed in the manufacture of car wheel iron and is otherwise well known.

The Kelly Iron Ore Corporation, 45 Exchange place, New York, has been organized with a capital stock of $250,000 and has elected the following officers: Robert D. McKay, president and manager; Charles H. McIntyre, secretary and treasurer; H. L. Davis, third director. This corporation has taken a 20 years' lease of the Kelly ore property, located at Boston Corners, and agrees to mine a minimum of 24,000 tons a year, at the outset, later increasing this to 100,000 tons. This property was operated for almost 30 years by open-cut methods by Eugene Kelly, but has been idle since his death. The ore body is a compact fissure vein about 100 feet wide and of unknown thickness. It dips at an angle of about 60 degrees under the mountain and the plan is to operate by tunnelling methods, going in through the present open pit. The ore is low in phosphorus and remarkably free from sulphur. The necessary machinery and equipment for opening the property are now being installed and accommodations made for about 100 men. Shipments will be over both the Harlem division of the New York Central and the New England division of the New York, New Haven & Hartford, both roads paralleling each other across the Kelly farm. An ore washer will be installed for a treatment of a part of the ore, though this is not necessary with the bulk of it.

The Dover Furnace Ore Co. has taken a lease of what is known as the Dover Furnace properties, located nearby and is preparing to begin shipments early in the year, as its lease calls for the removal of at least 100,000 tons annually. This mine was also originally operated open-cut, but the plan is to drive a slope in a broader section of the vein about 1,000 feet north of the old workings and to take out the ore in that direction. This mine will be reached by connection with the Harlem division of the New York Central. Officers of the Dover Furnace Ore Co., which is temporarily located at 115 Broadway, are John M. Coleman, president; S. H. Begent, treasurer, and C. F. Preston, superintendent.

The lease of the Kelly property was made by George Williams, a well-known ore man of that district, and the lease of the Dover Furnace property was made jointly by Mr. Williams and by the Miles Estate. It is understood that these ore deposits were at one time under lease of Milliken Bros., Inc.

## SUPERIOR COPPER PRODUCTION.

All of the Lake Superior copper mines are maintaining steady productions, and with but a few days of production remaining in the present year, it is estimated the total output of the district for the year 1909 will be around 235,000,000 pounds fine copper, says the *Mining World*. That production, if realized, will be the record for the district and will exceed last year's production by about 12,000,000 pounds. The local stocks of the metal at the several smelters are under normal. There are now 17 companies in this district making regular productions of copper.

## WILL SELL MAST PLANT.

An order has been issued by the federal court for the sale, on Jan. 22, of the plant of P. P. Mast & Co., Springfield, O., which has been in the hands of receivers for some time. The upset price, it is understood, is $235,000. The plant at one time was one of the largest implement manufactories in the world.

## MILWAUKEE TRADE SCHOOL BURNED.

The Milwaukee School of Trades was destroyed by fire early on the morning of Dec. 31. The loss is estimated at $50,000.

A special meeting of the stockholders of the Allegheny Steel Co. will be held Jan. 25 for the purpose of voting on a proposed increase in debt from $300,000 to $450,000.

# IMPORTANT DEVELOPMENTS OF A TWELVE-MONTH IN THE EAST

## TARIFF DISCUSSION WAS A FACTOR IN DELAYING RECOVERY,

### But Prosperity Was in Time Fully Established—Reduction in Duty Permits Heavy Importation of Scrap—Rail Buying Disappointing, but Many Orders for Equipment Placed.

By B. S. Stephenson.

The iron and steel industry entered the year 1909 with the conviction that conditions were ripe for the restoration of normal activities. The improvement noted in the closing months of 1908 was expected to continue until the last vestige of panic effects was swept away and the trade launched on a period of probably record prosperity. Within the twelve-months came the practical realization of these hopes, but the course of the industry toward that goal was by no means smooth and unbroken, for it led through the wondrous maze of tariff revision, in combination with the demoralized tendencies of a return to the open market.

Exactly to what extent the long-delayed settlement of the tariff uncertainties was responsible for the price reductions and discouragingly small progress of the steel industry during the first half cannot be stated. In most quarters it was credited with entire responsibility, and this is probably not far from correct, as a buoyant market with advancing prices developed immediately after congress finally adjourned in August. Naturally the eastern trade, facing the prospect of brisk European competition as soon as the protection of the tariff was reduced or removed, suffered most severely by reason of this uncertainty, but once the matter was decided, made the most of the activities of the last four months.

How complete has been the recovery is evidenced by the heavy production of October, when Corporation plants established 141 new records, including pig iron, ingots and other varied lines of finished products, and the output of many independent iron, ore and steel plants was similarly large. Earnings of the Corporation, always an important gage to conditions in the trade, declined during the first quarter only to show enormous increases for the second and third. The industry enters the new year with the expectation that it will have a place among the relatively few years of record activity and prosperity, and all indications point that way. The possibility of general labor difficulties constitutes no important menace, for they are the natural accompaniment of busy times and have been met successfully before.

#### Noteworthy Features.

Aside from the tariff reductions, which have let in large tonnages of British and continental steel scrap, considerable Middlesboro pig iron and European billets and bars in insignificant amounts, the past year presents several interesting features. Of importance to the east was the heavy importation of iron ore, resulting in the very general dropping of lake ores from eastern Pennsylvania and New Jersey furnace mixtures; this movement is not to be attributed to the lowered duty but rather to the fact that lake ores are now beyond the reach of these furnaces. Export trade was generally light, particularly during the last half, when domestic demands could scarcely be met. Structural bookings were heavy, but largely on an unprofitable basis. The railroads bought generously of rolling stock, which was cheap, and sparingly of rails, which will cost no more next year. Considerable progress was made along the lines of electric steel making, two Heroult furnaces and one of the Girod type being installed and announcement being made that an eastern billet mill would operate on steel from an electric furnace.

There were but two general gatherings of iron and steel manufacturers during the year, on June 19, when a considerable number were the guests of Judge Gary at a dinner to Sir Robert Hadfield, past president of the British Iron and Steel Institute, and Dr. Freiherr von Bodenhausen; and on Oct. 15, when Judge Gary was the guest of honor at a Waldorf banquet, tendered him by the steel trade in appreciation of his services in securing a spirit of co-operation and better understanding during the depression. In this connection he was presented with a magnificent gold vase.

#### The Year in the Steel Trade.

The declaration of the open market in steel products was made Feb. 18, following a meeting of prominent manufacturers, and the return to the old-time methods resulted in rather chaotic conditions during the ensuing months. On bars, shapes and plates, aggressive competition drove prices down to levels out of all proportion to raw material costs and contracts taken at these figures made their influence felt up to the end of the year. Prices on fabricated steel dropped to surprising levels and brought out a huge tonnage of work in New York and the east, the bulk of which was distributed among the numerous independent interests of that district.

Over the entire country during the first half bids were taken on over 1,000,000 tons of structural work, of which about 650,000 tons was let. Bookings of the American Bridge Co. for the year were but little below the 600,000-ton mark, comparing with a rated capacity of 720,000 tons. The close of the year saw mills generally well supplied with orders and conditions considerably improved, though fabricated steel prices in the Metropolitan district continued lower than in other important sections.

The several changes in structural steel interests of the east during the year are noted elsewhere in this review. Among the more important contracts closed were the following: Track elevation work of Reading system at Philadelphia, 17,000 tons, McClintic-Marshall Construction Co.; Gimbel store building in New York, 15,000 tons, Bethlehem steel fabricated by the receivers of Milliken Bros., Inc.; New York Central bridge and terminal work, 17,000 tons, American Bridge Co.; Curtis building at Philadelphia, 15,000 tons, American Bridge Co.; post office building at the Pennsylvania terminal in New York, 9,000 tons, Pennsylvania Steel Co.; Westchester railway requirements, 20,000 to 30,000 tons, American Bridge Co.; additions to Whitehall building, New York, 10,000 tons, Brown-Ketcham Iron Works, using Lackawanna steel; New England textile mill requirements, 25,000 tons, various interests; Brooklyn subway, 25,000 tons, American Bridge Co., excepting 2,000 tons to Lackawanna

Bridge Co. During the year the Bethlehem Steel Co. placed its special sections in numerous apartment and loft buildings in New York City.

### Steel Rail and Car Buying.

So far as eastern mills are concerned the year was disappointing in that rail purchases were considerably lighter than anticipated. Railroad buying in all directions was unimportant until the tariff uncertainties were largely removed, and during the last half of the year other necessities were supplied at the expense of the rail mills, there being no reason to place orders early with a view to insuring 1910 deliveries, as was the case in the west to a considerable degree. At the beginning of the year mills over the country were operating only about 45 per cent of capacity. The New York Central placed orders for 101,000 tons on March 1, and other scattered buying was done, but only enough to permit mills to run intermittently. The Ensley mill was closed down entirely for a considerable part of the summer and two other large producers changed a part of their rail capacity to billets, the Sparrows Point mill taking an extremely large order for western delivery late in the year. The Corporation opened its books for 1910 business about the middle of August and entered some important orders, chiefly from western roads. The Pennsylvania order for 200,000 tons was announced in September, and the New York Central tonnage a little later.

Doubtless one cause of the light rail buying was the decision of many important railway interests to avail themselves of the low prices prevailing on cars. Orders for rolling stock placed by the Baltimore & Ohio, Pennsylvania, New York Central and Harriman systems in particular were among the largest ever entered and, in connection with buying by less important lines, have filled up car-building and locomotive shops well into 1910.

Manufacturers of steel plates, boiler tubes and steel underframes were called upon to supply equipment interests with heavy tonnages, while makers of bar iron, steel bars, malleable castings and similar products benefited materially through the buying of both railway and equipment shops. Eastern plate makers closed the year with a price of 1.60c, Pittsburg, well established. The billet output proved inadequate to meet current demands during the last half and mills found no difficulty in securing $30 for their product. With several interests deliveries fell considerably behind.

### Pig Iron in the East.

The following table, showing representative prices of basic and No. 2X foundry, delivered at eastern Pennsylvania points, accurately reflects the trend of the market through the year:

| | Basic | No. 2X Fdy. |
|---|---|---|
| January | $16.75 to 17.25 | $17.00 to 17.50 |
| February | 16.50 to 17.00 | 16.75 to 17.25 |
| March | 16.00 to 16.50 | 16.25 to 16.75 |
| April | 15.75 to 16.25 | 16.00 to 16.50 |
| May | 15.00 to 15.25 | 16.00 to 16.50 |
| June | 15.50 to 16.00 | 16.50 to 17.00 |
| July | 15.75 to 16.25 | 16.50 to 17.00 |
| August | 17.00 to 17.50 | 17.00 to 17.50 |
| September | 18.00 to 18.50 | 18.00 to 18.50 |
| October | 18.50 to 19.00 | 18.75 to 19.25 |
| November | 18.50 to 19.00 | 19.00 to 19.50 |
| December | 18.75 to 19.00 | 19.00 to 19.50 |

Blast furnace interests in eastern Pennsylvania and New Jersey entered the year prepared to take full advantage of any improvement in the trade. By reason of curtailed operations during 1908, they had accumulated no stocks of importance, and their raw material requirements were covered at low figures. There were heavy stocks on the yards of the leading Virginia producer, eventually reaching the 200,000-ton mark, but these were firmly held and did not constitute a weakening factor in the market. The Buffalo accumulations, largely disposed of during the year in the New England district, proved a source of greater concern. Moderate activity during the first few weeks of the year was followed by a period of extreme quiet, resulting in a gradual decline until May, with some increase in stocks. The market remained near the low level until August, when the removal of the tariff uncertainties was followed by a buying movement which sent prices up sharply. December selling was generally light, but the year ended with prices near the highest reached by the advance.

Some large blocks of basic sold in January on a delivered price of $17, and moderate selling accompanied the decline until about the middle of May, when two large furnace interests near Philadelphia opened their books at $15, delivered, starting a buying movement involving some 200,000 tons. June and July saw further buying at $15.50 and $16, and early in August several large consumers entered the market, with the result that prices advanced almost $2 per ton. September buying established the market $1 higher and the last three months witnessed the closing of a heavy tonnage at from $18.50 to $19, delivered, the latter price being paid for fair lots of both Virginia and eastern Pennsylvania basic. The year ended with consumers well covered for the first quarter and in some cases for the first half, while producers had little to offer before the second quarter. Five or six additional stacks will become operative during 1910. Standard low phosphorus iron opened the year at $21.50, delivered at eastern Pennsylvania plant, shaded off to $19 in July, and advanced sharply during October, closing the year at a minimum of $22.75. Brisk buying developed in November and December, following the removal of British competition by the advance abroad.

Comment on the foundry iron market is unnecessary. The year witnessed a steady increase in the demand from foundries; railway shops and equipment concerns contributed largely to the improved business, and in all lines of consumption a substantial betterment was indicated. The competition from British iron was never a factor of importance. Pipe works bought good tonnages throughout the year, though generally following, rather than anticipating, the advances.

The blast furnace activities of the Corporation were about 57 per cent of normal at the beginning of 1909; by July 1 this had increased to 87 per cent, or practically normal as compared with the capacity available the year previous. On Sept. 1 this was up to 95 per cent, and this rate, although greater than can be counted upon regularly, was continued up to Jan. 1 with little change.

The year was featured by the efforts of the Philadelphia Foundrymen's Association and other interested bodies to make general the practice of buying iron by analysis. Also of interest to the trade was the taking over of N. S. Bartlett & Co., long a factor of importance in the eastern market, by Hickman, Williams & Co.

### Production Costs Increase.

In view of the low iron prices prevailing over the first seven months of the year, it was only a fortunate combination of cheap materials, in connection with wage reductions of about 10 per cent, which permitted the continuation of blast furnace operations in the east. The item of ore cost was kept down by eliminating the use of Lake Superior product—with the exception of some lots secured at heavy concessions because of unusual analysis—and by relying completely on local, Champlain and foreign ores, which yielded a satisfactory mixture at a cost well under that possible with a liberal use of lake ore. Prices on

the ores employed were particularly favorable during the summer months, the buyers benefiting by the tariff reduction, but during the fall considerable advances were made and contracts for 1910 were closed at an average of fully 1 cent per unit over the low figure for 1909.

The sensational advance in coke came with the close of summer, up to which time an ample supply was available at remarkably low prices, another factor making for the salvation of the eastern furnacemen. The upward movement, when it finally developed, was so rapid and far-reaching that actual instances were on record where large consumers, filling their coke requirements on the extension of old contracts at low figures, were quoted double those prices for new contracts by the same producing interests. Eastern furnacemen, however, had largely covered their first half needs before the advance set in. Those who had not done so were slow to contract and recently have received offers well below the top figures reached. The wage reductions, generally announced in the spring, were restored as soon as warranted by the improvement of the late summer.

### Pig Iron From Abroad.

The importation movement was confined to the last quarter of the year, the first cargoes of Middlesboro iron being arranged for about Oct. 1. The British trade has been free to express its disappointment at the limited tonnage brought over, several American interests preferring to take their moderate profits on Cleveland warrants rather than undertake the risks involved in bringing in the iron called for. With possibly one or two exceptions, the movement was entirely in the hands of pig iron dealers who did not figure in the heavy importing of 1907, and few of the cargoes received showed profits commensurate with the risks involved. Inasmuch as the price at which British iron could be landed, duty paid, was but little under that of domestic iron at furnaces near the seaboard, the entire importation movement may be attributed to the tariff reduction from $4 to $2.50 per ton. One or two cargoes arranged for by pipe interests were evidently brought over more for their moral effect on eastern furnacemen than because of actual needs. The prospect is that importations will not be heavy during 1910 unless pig iron conditions approaching a famine develop in the east.

### Ferro Alloys and the Tariff.

Ferro-manganese was selling one year ago at $44.00 to $45.00, seaboard, or substantially at the present level, or a net advance of about $1.50, taking into consideration the tariff reduction. During the summer prices sagged to about $40.00 and the larger consumers covered well into 1910. An advance of importance has been anticipated for some months and several times during the fall there were indications that it had set in, but the year closed with this alloy rather weak and no big business in early prospect. Heavy purchases of ferro-silicon, made by speculative interests in anticipation of the tariff advance, have held the market rather steady at about $62.50, Pittsburg, throughout the year. Two or three important blocks of foreign spiegeleisen were taken by eastern steel interests early in the fall, with which exceptions the market has been dull and featureless. Tungsten metal and ore advanced sharply late in the year.

### Bar Iron and Pipe.

Bar iron mills suffered severely, particularly during the early part of the year, because of the heavy tonnage diverted to steel bars by reason of the low prices prevailing and felt the effect of this competition all through the year because of contracts closed on this basis. Refined bar iron was selling at 1.45c to 1.50c, eastern mills, on Jan. 1, 1909, but rapidly declined to a minimum of 1.20c or 1.25c, eventually recovering this loss and establishing itself firmly at a minimum of 1.50c, mills, with some interests securing $2.00 or $3.00 per ton higher. Operations were fairly good during the fall months and the year ended with improved business in prospect because of the strength of steel bars.

For the first nine months of the year cast iron pipe manufacturers secured orders sufficient to maintain operations at a satisfactory rate, but were badly embarrassed by the continuance of low prices, which showed practically no margin over the material and labor costs. Even when prices began to advance during the fall it was only after pig iron had reached higher levels. A pronounced scarcity of pipe-making grades was experienced through the year and some importation was done by tidewater foundries. New York City bought largely during the last half and the tonnage placed by consumers in New England and elsewhere for 1910 delivery was larger than usual, though in the Metropolitan district the competition from steel pipe for the larger water propositions was keen. One of the largest cast iron pipe contracts recently closed was 45,000 tons for San Francisco, secured by the leading interest.

### Developments in Scrap.

The scrap market in the east during 1909 presented several unusual features, prominent among which were the innovations of a heavy import movement and of a joint purchasing arrangement among most of the important consuming interests in the eastern half of Pennsylvania. The first seven months of the year witnessed radical changes in the price of heavy melting steel scrap. Early in January mills were offering $17.00, delivered, and the market was fairly strong at that figure, but this condition immediately resulted in the substitution of basic iron in the mixture of several large consumers and occasioned a decline which, before the end of the first quarter, amounted to about $4.00 per ton. The bottom was reached in April, but by this time basic iron also had slumped badly and continued low until late in the summer, retarding the recovery of scrap prices to a considerable degree.

Following the settling of tariff uncertainties and the clearing of the ways for record steel activities during the fall, basic iron began a sharp advance in August and heavy melting steel gave promise of a similar movement. Conditions were ripe for a runaway market. Over a long period operations had been light in those branches of the industry producing the bulk of this scrap, and such tonnage as had accumulated over the current demand had found its way into strong speculative hands; the steel mills were rapidly approaching normal activities and their demands for scrap were greater than could be filled through the regular channels.

But at this stage two steadying factors intervened. Taking advantage of the reduction in duty to $1.00 per ton and of the relative inactivity of the trans-Atlantic steel trade, dealers began the importation of British and Belgian scrap in large amounts, which, consisting chiefly of crop ends and other carefully selected material in order to minimize the danger of loss through rejection on this side, speedily found favor with eastern steel works. Some difficulty was encountered at the outset by reason of an unnecessarily strict tariff ruling as to what constituted "scrap" under the new schedule, but importations continued at a heavy rate

through the remainder of the year, although near its close the growing scarcity of desirable scrap abroad brought about an advance which threatened to end the movement.

The joint buying arrangement was announced early in August, the plan being that a leading Philadelphia dealer should purchase the requirements of the following large consumers: Bethlehem Steel Co., Lukens Iron & Steel Co., Pennsylvania Steel Co., Phoenix Iron Co., John A. Roebling's Sons Co., Alan Wood Iron & Steel Co., and Worth Bros. Co., leaving only the Pencoyd works of the American Bridge Co., the Eastern Steel Co. and two or three other important steel works non-parties to the arrangement. Although stubbornly opposed by several large dealers, the movement has so far proved successful and is credited with having prevented steel scrap from soaring to abnormal heights and, more recently with having held it up when the market had weakened through heavy importations and the release of accumulated stocks.

Rolling mill materials were in irregular demand over the last half of the year, with a steadily improving demand from the foundry trade. Interest centered for a time in the efforts of the Panama authorities to dispose of the accumulations along the canal route, variously estimated at from 80,000 to 120,000 tons. After several dealers had visited the canal zone and bids on the entire tonnage had been opened, protests were registered by a number of unsuccessful bidders and no award was made. Instead it was decided to sell the material in ship lots on its arrival at New York as return cargo for cement vessels. During the last quarter considerable miscellaneous scrap was received at Philadelphia from Galveston, New Orleans, the West Indies and other southern points, from Canada, Newfoundland and San Francisco.

The extent to which sharp flucuations have been eliminated since the joint buying arrangement was launched may be seen from the following table, giving average prices on choice heavy melting steel scrap delivered at consuming points in eastern Pennsylvania:

| | |
|---|---|
| January | $17.00 to $17.50 |
| February | 15.50 to 16.00 |
| March | 13.75 to 14.25 |
| April | 13.50 to 14.00 |
| May | 14.50 to 15.00 |
| June | 15.50 to 16.00 |
| July | 16.00 to 16.50 |
| August | 17.00 to 17.50 |
| September | 17.50 to 18.00 |
| October | 18.00 to 18.50 |
| November | 18.00 to 18.25 |
| December | 17.25 to 17.75 |

**Removing Effects of Panic.**

Advantage was taken of the year's returning activities to reorganize a number of steel concerns which had fallen into financial difficulties during the depression. Only one important interest was added to the list of unfortunates during 1909,—in March receivers were appointed for the J. B. & J. M. Cornell Co., one of the oldest structural companies in New York,—while numerous receiverships and trusteeships were terminated.

One of the first concerns to be reorganized was the Southern Steel Co., which had gone into receivers' hands Oct. 25, 1907. After considerable litigation this was reorganized as the Southern Steel & Iron Co., with a capitalization of $17,000,000 and a strong directorate, which is making heavy expenditures on its Gadsden works.

Another southern interest, the Sheffield Coal & Iron Co., was also put on a sound financial basis and took over the properties of the New Jersey corporation of that name early in March; its directory board includes several names ranking high in steel and financial circles.

Interests associated with the Union Drawn Steel Co. assumed control of the New York State Steel Co. properties at Buffalo in January, and rushed its 450-ton blast furnace to completion, besides operating its mills to capacity.

In September the Tidewater Steel Co. properties at Chester, Pa., were acquired by a number of western iron and steel men, who organized the Delaware River Steel Co., and immediately arranged to operate the blast furnace; no announcement is made regarding the steel works, which have been idle for several years.

The reorganization plan proposed by the creditors' committee for Milliken Bros., Inc., was declared operative late in November, when the receivers were discharged and the properties were taken over by a company headed by E. C. Wallace, with a directory board including several men well known in the iron trade. For the present only the structural shops on Staten Island will be operated.

After repeated postponements occasioned by legal complications, the Passaic Steel Co. properties at Paterson, N. J., were finally sold at auction to representatives of the bondholders, with the expectation that the works would be operated under a reorganization. With the exception of the Cornell company, this clears away the last wreckage of the recent panic in the steel industry of the east.

**Additions to Capacity.**

An interesting feature in connection with announcements of important additions to eastern steel works during the year is the rapidity with which the duplex process is being adopted. The Pennsylvania Steel Co. has supplied its Steelton works principally in this way of late and will employ the process at Sparrows Point. More recently the decision has been reached to employ it at South Bethlehem. The following paragraphs enumerate and outline the more important extensions begun or announced during the past year in the eastern district:

Bethlehem Steel Co., South Bethlehem, Pa.; two additional blast furnaces; two 20-ton Bessemer converters to supply hot metal to present open-hearth furnaces, doubling their capacity; installation of Grey mill for small beams, replacing present standard structural mill; and other improvements aggregating expenditure of about $6,000,000.

Maryland Steel Co., Sparrows Point, Md.; ground broken June 1 for five 50-ton open-hearth furnaces to operate with present Bessemer converter by the duplex process; docks and ore-handling equipment costing about $500,000 and incidental improvements.

Eastern Steel Co., Pottsville, Pa.; construction begun in December on two 80-ton open-hearth furnaces, increasing steel capacity of works about 80 per cent; also improvements in shipping yards.

American Iron & Steel Mfg. Co., Lebanon, Pa.; announced decision late in year to install billet mill with capacity of 50,000 to 60,000 tons yearly, to meet its own requirements; this mill to operate on electric furnace steel.

Phoenix Iron Co., Phoenixville, Pa.; recently completed a 125-ton open-hearth furnace.

Reading Iron Co., Reading, Pa., addition to tube works near completion; new puddle mill to be installed; two large mill buildings completed during the year.

Worth Bros. Co., Coatesville, Pa.; one 500-ton furnace practically completed; work progressing on second stack; miscellaneous improvements to finishing mills.

Joseph E. Thropp, Everett, Pa.; Everett furnace rebuilt with annual capacity of 100,000 tons.

E. & G. Brooke Iron Co., Birdsboro, Pa.; rebuilding No. blast furnace to

operate in connection with Gayley dry air blast.

Hudson Iron Co., New York City; rebuilding Secaucus furnace, increasing annual capacity to 70,000 tons.

American Steel & Wire Co., Worcester, Mass.; 15-ton Heroult electric furnace installed ready to begin operations in connection with basic open-hearth plant.

Lackawanna Bridge Co., Buffalo, N. Y.; operations begun in structural steel shop with annual capacity of 40,000 tons.

Metropolitan Bridge Co., Jersey City, N. J.; operations begun in structural steel shop with annual capacity of 15,000 tons.

### Machine Tool Trade.

Manufacturers of machine tools and other metal working equipment have had little cause for complaint during the latter half of the year. Even when the depression was at its worst a brisk demand for certain classes of machine tools from the automobile makers gave some activity to the industry and, since purchasing has been resumed by the normal users, deliveries in gear cutters, automatic screw machinery, milling machines and allied lines have steadily dropped behind. Railway equipment makers, automobile factories, steel works and the Isthmian commission have contributed most largely to the business of the past year, though individual lists of importance have not been numerous. Late in the year a much needed reform was brought about in the standardization of the engine lathe swing and of the milling machine stroke. Price concessions during the depression were not general, hence the year saw only scattered advances, principally during the last quarter. The outlook in this field is most encouraging.

### Corporation Changes.

The death of Henry H. Rogers, May 19, removed a director of the United States Steel Corporation who had been a member of the finance committee since its organization. He was succeeded, on both the board and committee, by J. P. Morgan Jr. Two other changes were made in the Corporation board during the year. Following the December meeting, it was announced that Marvin Hughitt and William Edenborn had resigned and that their places had been taken by Percival Roberts Jr., a member of the board early in the Corporation's history, and Samuel Mather, identified with the Lackawanna Steel Co., and other independent interests. The retirement of James Gayley resulted in the election of William B. Dickson as first vice president of the Corporation and of Daniel G. Kerr as second vice president.

Joseph Wharton, president of the Wharton Steel Co., died Jan. 11, at the age of 83. Aside from being president of the American Iron & Steel Association, he was in many respects one of the most interesting and best known figures in the eastern iron trade. Less than a fortnight before his death, Mr. Wharton received a letter from James M. Swank, resigning as general manager of the American Iron & Steel Association, after a connection of 36 years with that organization. Mr. Swank, however, has continued its efficient work during the year.

# YEAR OF IMPORTANT EVENTS AT PITTSBURG

## GREAT STEEL INDUSTRY RECOVERS FROM SEVERE DEPRESSION

**Orderly Readjustment, With Some Low Prices, Follows Declaration of Open Market—Selling Ability Put to Severe Tests—Leading Events Affecting Employer and Employe—New Construction**

By Chas. J. Stark.

Opening, the year 1909 brought to the iron and steel industry, a prospect of quietness and uncertainty of trade, of great and vital problems unsolved, of guarded optimism and divided sentiment.

Closing, it finds the industry upon the threshold of what appears likely to be one of the fullest and most fruitful periods in all its varied course of high prosperity and extreme depression.

The development of this improvement has been attended by events that characterize the year as one of the most remarkable and important in the recent history of American iron and steel manufacture. From the unusual conditions existing, there have arisen practices which seem likely to become fixed as new precedents of the business.

Two great factors stand out conspicuously among the ends accomplished. These are, the restoration of the industry to a normal basis and the adjustment of the effect of the tariff revision. The former was attained in a degree to fulfill the most optimistic predictions through the expedient of open market conditions; the orderly and prompt manner in which the duty reductions were accepted without the predicted harmful effects, leave the open question as to whether the importance of the tariff factor was not exaggerated.

### Test of Sagacity.

The year has been one to fully test the sagacity and the farsighted wisdom of selling organizations. With the basis of definite price levels suddenly removed through the abrupt declaration of an open market by the United States Steel Corporation, there was thrust upon the iron and steel makers of the country, a situation where individual policies were made necessary in a more pronounced degree than for years. In the absence of the so-called official prices and the seeming abandonment of the established precedents of the trade, there was early precipitated a confusion of the real significance of conditions and an apprehension of competitive methods to be practiced. More mature developments emphasized this fallacy and brought sentiment to its proper form, but out of the uncertainty came the influences that prompted the selling of steel bars down to 1.10c. Pittsburg, plates and shapes to 1.20c Pittsburg and other products to corresponding levels.

The new order of conditions in the selling end of the industry has been accompanied by developments of notable significance. Chief among these has been the restriction of the familiar optional contract which in times past, generally speaking, has enabled a buyer to specify much or little tonnage within his own estimate of requirements ac-

cording to the advantage to be derived from the current level of prices. At the same time, it left no absolute assurance to the mills of the tonnage likely to be taken out. Some of the leading steel makers have made important modifications of their policies in this direction and are now limiting their contracts to those for fixed tonnages for specific work or to a covering of estimated requirements for a given period in which the quantities to be taken out at agreed intervals at the stated price, are determined. The results arising from this method of negotiation are a more effective control of the speculative element in trading and the reasonable assurance that most of the tonnage upon makers' books will reach the mills. This latter consideration is of importance in giving more uniformity to mill operations with a corresponding benefit in the consistent delivery service extended to buyers.

Through the conditions imposed by the open market, there has also been apparent a less strict adherence to the time honored Pittsburg basis for prices. Quotations at maker's mill with the absorption by the seller of all or a part of the Pittsburg freight, were frequently adopted in the year and the plan has accrued to the favor of the well located buyer. This practice is still quite general in the semi-finished market though in the finished products, the settling of prices to an unofficial but well understood Pittsburg level, has made this course less necessary or advisable on the part of makers. The decision of the Carnegie Steel Co. to extend its warehouse system to Pittsburg territory is especially interesting.

### Construction Work Renewed.

The first conclusive evidence of the returning tide of normal business to the industry, was the signal in the Pittsburg district for the taking up anew of contemplated or half developed plans for capacity extensions which had temporarily been consigned to the deferred class. The Jones & Laughlin Steel Co., after leisurely carrying on the development of its large construction plans at Aliquippa, actively resumed work upon the project in May. The erection of these extensive works is now being pushed steadily; one blast furnace has already been blown in, others are nearing completion, while contracts have been let and the work advanced on blooming, billet and sheet bar, tin plate, wire and wire rod mills. The Carnegie Steel Co., in November also announced its purpose to proceed with the erection of a large group of merchant mills in the Youngstown district, an improvement that had been in serious contemplation before the depression of business. The ultimate result of this construction is likely to be the abandonment of the less modern merchant mills located in the city of Pittsburg proper, where high rentals and taxes as well as less efficient operations have presented possibilities for the material reduction of fixed charges. The building of the Girard mills subsequent to the completion of additional steel making capacity at the Ohio works, Youngstown, from which they will draw their raw material, follows the well understood plan of the company to concentrate its various finishing activities in units in different districts as far as possible. The plan of the American Sheet & Tin Plate Co. to provide large sheet and tin plate capacity at Gary, Ind., upon which it is officially announced work will go forward at once, is evidently the forerunner of a gradual decline of the importance of the Wheeling district as an operating center, because of the serious labor obstacles there encountered.

One of the most important pieces of construction in the Pittsburg district by an interest not hitherto a steel maker is the new open hearth plant and slabbing mill under erection at Butler, Pa, by the Forged Steel Wheel Co., a subsidiary of the Standard Steel Car Co. The Standard Steel Car Co. is at present a large buyer of steel material from the Carnegie Steel Co. and the Illinois Steel Co. The West Penn Steel Co. also built and started a four mill sheet plant and an open hearth department at Brackenridge, Pa. The duplex method of steel making found its way to the Pittsburg district in the year and is now being practiced at the South Side works of the Jones & Laughlin Steel Co.

### Pig Iron.

At the beginning of the year, there were heavy stocks of pig iron in the yards of those makers in Pittsburg and valley territory who had maintained their operations during the comparatively dull months of 1908 at a rate somewhat in advance of consuming needs. The extent of the improvement in the market over the year finds illustration in the fact that at the present time these stocks have been reduced to a point where they are no longer unwieldy, and this condition has been reached in the face of gradually increased furnace activities and a total production which from September on attained the highest point in the history of the iron and steel industry. One large Pittsburg steel interest alone, which had piled several hundred thousand tons during the depression, found itself obliged, despite its high tide furnace driving to enter the market and purchase a tonnage estimated at about 100,000.

Pig iron prices showed a continued weakening over the first five months and the market gave evidence of being afflicted with a state of over production. The turning point was reached in May when the steel makers, experiencing the beneficial effects brought by the open market expedient, had greatly increased their melting tonnage and the dependent lines of industry had begun to be similarly improved. The upward movement continued from May to November, netting recoveries of approximately $4.50 in Bessemer and $3.25 in basic and $3 in foundry and forge grades. The customary quietness in December left the tone of the market easier, but quotations were reasonably firm due to the prospects of increased costs in the first quarter and first half, arising from the advances in ore and coke. The usual

**Average Monthly Prices, Iron and Steel Products, Pittsburg, 1909.**

| | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bessemer Pig Iron | $17.34 | $16.78 | $16.34 | $15.80 | $15.48 | $16.13 | $16.37 | $17.13 | $18 33 | $19.68 | $19.90 | $19.90 |
| Basic Pig Iron | 16.40 | 16.09 | 15.84 | 15.05 | 15.02 | 15.84 | 15.90 | 16.17 | 16.80 | 17.84 | 18.37 | 18.15 |
| No. 2 Foundry | 16.25 | 15.90 | 15.75 | 15.15 | 15.25 | 15.75 | 16.15 | 16.25 | 17.15 | 18.00 | 18.15 | 18.15 |
| Gray Forge Iron | 15.40 | 15.25 | 14.90 | 14.40 | 14.50 | 14.75 | 14 90 | 15.00 | 16.00 | 17.15 | 17.40 | 17.25 |
| Ferro-Manganese | 44.00 | 44.00 | 42.50 | 41.50 | 41.00 | 41.00 | 41.50 | 41.50 | 42 50 | 43.00 | 44.50 | 45.00 |
| Bessemer Billets, 4 x 4 | 25.00 | 23.50 | 23.00 | 22.00 | 22.50 | 23.00 | 24.00 | 25.00 | 26 00 | 26.50 | 27.50 | 27.50 |
| Rails (Standards) | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 28 00 | 28.00 | 28.00 | 28.00 | 28.00 | 28 00 |
| Beams and Channels (15 inches and under) | 1.60c | 1.45c | 1.30c | 1.20c | 1.25c | 1.30c | 1.35c | 1.40c | 1.50c | 1.50c | 1.55c | 1.60c |
| Tank Plates | 1.60c | 1.45c | 1.30c | 1.20c | 1.25c | 1.30c | 1.35c | 1.40c | 1.50c | 1.50c | 1.55c | 1.60c |
| Steel Bars | 1.40c | 1.30c | 1.20c | 1.15c | 1.20c | 1.20c | 1.25c | 1.35c | 1.40c | 1.40c | 1.45c | 1.50c |
| Bar Iron | 1.50c | 1.45c | 1.40c | 1.35c | 1.30c | 1.40c | 1.40c | 1.45c | 1.55c | 1.65c | 1.70c | 1.75c |
| Sheets (28 gage black) | 2.40c | 2.40c | 2.30c | 2.20c | 2.20c | 2.20c | 2.20c | 2.20c | 2.20c | 2.30c | 2.40c | 2.40c |
| Sheets (28 gage galvanized) | 3.55c | 3.55c | 3.30c | 3.25c | 3.25c | 3.25c | 3.25c | 3.25c | 3.25c | 3.30c | 3.50c | 3.50c |
| Tin Plate | $ 3.70 | $ 3.70 | $ 3.55 | $ 3.45 | $ 3.45 | $ 3.45 | $ 3 45 | $ 3.45 | $ 3.45 | $ 3.50 | $ 3.60 | $ 3 60 |
| Wire Nails (jobbers) | 1.95c | 1.95c | 1.95c | 1.95c | 1.60c | 1.70c | 1.70c | 1.80c | 1.80c | 1.80c | 1.80c | 1.85c |
| Hoops | 1.80c | 1.75c | 1.60c | 1.60c | 1.50c | 1.40c | 1.40c | 1.40c | 1.50c | 1.50c | 1.50c | 1.55c |
| Heavy Melting Steel | $16.50 | $15.75 | $14.50 | 14.15 | $15.00 | $16.00 | $15.75 | $16.25 | $17.25 | $18.25 | $18.00 | $18.00 |

spread of $1 a ton between Bessemer and basic was enlarged, and this development is attributed to the greater demand for the former grade and to the limited field of Bessemer production, growing out of the more closely held condition of standard Bessemer ores.

The greatest buying activity fell in the months of September, October and November when the capacity operations of blast furnaces and finishing mills forced a number of the leading steel makers into the market as heavy buyers. The total reported sales of Bessemer iron for these three months reached 386,900 tons divided into 152,600 tons in September, 165,000 tons in October and 69,300 tons in November. The buying movement in Bessemer was inaugurated late in June, when the Jones & Laughlin Steel Co. closed for 25,000 tons for third quarter from the Bessemer Pig Iron Association at $15.25 valley. The Youngstown Sheet & Tube Co. followed with a purchase of 25,000 tons for last half at $15.50 valley, and the rising movement in Bessemer was then fully under way. The last important sale of the year was that of 18,000 tons to the Republic Iron & Steel Co. for first quarter shipment at $19 valley. The Youngstown Sheet & Tube Co. was the heaviest single buyer of Bessemer iron in the year, closing during the last half for about 125,000 tons. The other important buyers reported were, the Jones & Laughlin Steel Co., 70,000 tons; Republic Iron & Steel Co., 68,000 tons; Cambria Steel Co., 64,000 tons, and the Lackawanna Steel Co., 20,000 tons. The most notable transaction of the year in point of tonnage was that closed by the Cambria Steel Co., in October for 57,000 tons, including 3,000 tons of basic for delivery over the remainder of the year. Most of the iron figuring in the large Bessemer transactions was contracted with the Bessemer Pig Iron Association and W. P. Snyder & Co., Pittsburg. The latter was frequently a buyer of scattering tonnages from other interests to apply upon these contracts. At the year's close, the Jones & Laughlin Steel Co., having blown in one of its new Aliquippa furnaces and with two others nearing completion, did not appear likely to be a further buyer of importance. The Youngstown Sheet & Tube Co., and the Republic Iron & Steel Co., both had an additional furnace in course of erection. Both of these companies however, were expected to enter the market again before the additional capacity is in operation, provided the pressure for steel for finishing mill needs continues.

Blast furnace operations in the Pittsburg district and adjacent territory reached the highest point during the last quarter of the year, and contributed their share to the record production of the country during the final three months. At the year's end, 55 of the 56 steel working furnaces in the Pittsburg-Johnstown district were in operation, and five of the six merchant furnaces classified under this group were in blast. Of the 18 merchant furnaces in the Mahoning and Shenango valleys, 16 were blowing, the idle stacks being Fannie at West Middlesex, Pa., and one Andrews & Hitchcock, at Hubbard, O.

### Semi-Finished Material.

More or less indefiniteness has characterized the semi-finished steel situation in the year. During the early dull months, the market was without much life by reason of the fact that buying consumers were practically all covered through their regular sources of supply on full year or long term contracts based upon sliding scales or other special arrangements. Prices accordingly were slow to establish themselves after the open market was declared. When the finishing demands of steel makers began to reach larger proportions, the movement advanced so rapidly that some companies found themselves oversold against their raw steel capacity, and there were prominent instances of makers buying from one another. Toward the close of the year when the consideration of contract renewals was taken up, buyers, particularly in sheet bars, found themselves confronted by a strong disposition on the part of steel interests to conserve their supplies of steel because of the active market for finished products and because of the additional requirements of their own new finishing capacity which had been started or completed after the recovery of business vigor. There was also in prospect increased needs from new finishing mills under construction which had included no open hearth or Bessemer departments in their operations. These conditions combined to produce high prices and sales of prompt sheet bars were made at slightly over $30 mill. The first quarter market remained somewhat indefinite and appeared at about $29 to $29.50 Pittsburg. Forging billets were extremely scarce and sold as high as $33 Pittsburg. At the present time there is general activity in the Pittsburg district in the way of new steel works construction, and a number of companies are bending their efforts toward placing themselves in a self contained position as to their crude material needs.

### Merchant Bars.

At the close of the year 1909, steel bar consumption in the country was authoritatively estimated to be running at the rate of about 4,200,000 tons annually, which is the highest point ever reached by this product. No finished line has enjoyed the percentage of increase in recent consumption of that of the steel bar mill, which has been contributed to materially by the great expansion of the automobile industry, of reinforced concrete construction, of the manufacture of metal specialties and of other important manufacturing activities. The farming communities are also absorbing larger quantities of steel bars than ever before. During the early part of the year, the market was lacking in tone, but following the elimination of considerable of the prevalent price disturbances, the tonnage from the mills began to run heavily to the trade, and from March to December there was a consistent shattering of monthly records in specifications entered. Mill capacities became taxed to the utmost and the opening of 1910 found makers sold up in certain sizes fully six months ahead, while some of the leading interests had withdrawn completely from the market. The great demand for steel bars has acted as a spur upon tentative plans for new merchant mill construction, and the Carnegie Steel Co., in November announced plans for large extensions of capacity to be located along the Mahoning river opposite Girard, O., and which eventually will have a monthly output of 60,000 to 65,000 tons. The Jones & Laughlin Steel Co. also made some additions to its bar mill capacity at its South Side plant, Pittsburg, during the year. Prices of steel bars showed considerable range during the year. Shortly after the declaration of the open market in February, some interests displayed aggressive selling tactics and forward contracts were closed down to 1.10c Pittsburg. The market gradually reacted from that point to a minimum of 1.50c at the year end. A very heavy tonnage was placed under contract to Oct. 1 and to Jan. 1 at prices around 1.10c, 1.15c, and 1.20c, and buyers grasped their opportunity by specifying these engagements in full within the time limits prescribed. This was a factor of importance in the heavy run of mill orders up to Jan. 1.

Bar iron gradually declined with steel bars in the early part of the year, but as plant operations increased and scrap prices became ascendant, the market gradually strengthened and was holding very firm in Pittsburg territory at the close. The range of prices in the year

was from 1.30c in May to 1.70c in December. Trading in bar iron over the year was rather dull because of the inability of makers to compete with low prices ruling on steel bars. As the steel bar mills became filled with tonnage, some business was diverted to the iron plants. A notable change in mill conditions was the abandonment as an iron plant of the historic Brown-Bonnell works at Youngstown, O., by the Republic Iron & Steel Co. New continuous mills have been installed and the plant has been put upon a strictly steel basis.

**Plates.**

Active car buying in 1909, which was about double that of 1908, but not quite equal to that of 1907, was an important factor during the final seven months in bringing plate production of the past year to fair proportions. The estimated output of the plate mills in 1909 is 1,750,000 net tons. The total number of freight cars ordered in the year was about 125,000 compared with 63,000 in 1908 and 151,000 in 1907. An increasing adoption of the all steel and steel underframe types of cars by the railroads has contributed to a greater demand for steel material from the mills. Among the principal single lots ordered in the year were: Pennsylvania lines, 10,000; New York Central, 10,000; Baltimore & Ohio, 5,000; Harriman lines, 5,000 and Santa Fe system, 10,000. At the beginning of the new year, the leading car builders had booked heavily for a number of months ahead, and were specifying liberally for material, so that the plate mills had about all the tonnage they could conveniently handle, and deliveries had been extended to three and four months. The prospects for further active car buying are quite favorable. General building construction in 1909 was good and this was an important factor in the more active plate market. Steel boat building in 1909 was not of notable proportions, but the prospects for 1910 are considerably improved. Plate prices in the year suffered from the open market conditions, and the extreme mark of 1.20c was reached during the latter part of the first and early in the second quarter. The market began to strengthen in May, however, and gradually inclined upward to a minimum of 1.55c and a general level of 1.60c at the end of December.

**Structural Material.**

Though the fabricating interests booked a much larger tonnage in 1909 than in 1908, considerable of it did not come out until the year had well advanced, and the shape mills were not able to operate at full schedules throughout the 12 months. Total production, however, showed a marked increase over the preceding year and is roughly estimated at from 1,300,000 to 1,350,000 net tons compared with 1,083,000 net tons in 1908 and 1,940,000 net tons in 1907. The American Bridge Co., with a rated annual capacity of about 750,000 tons, booked less than 600,000 tons while the approximate aggregate of the business going to the independents was from 750,000 to 800,000 tons. At the close of the year, the American Bridge Co. had more than 100,000 tons of undelivered contracts upon its books. During the major part of the year, there was a brisk competition for business among fabricators, and especially low prices often developed. The average fabricated price per ton on regular work was probably less than for several years. Offsetting the smaller returns from contracts were the lower prices prevailing in plain material and a number of the structural shops were enabled to cover for their steel requirements over extended periods at quotations scaling down to 1.20c Pittsburg. The market on plain material re-established itself steadily over the last eight months and the closing level in December was about 1.60c. Many builders took advantage of the lower cost of steel construction during the year and pushed ahead projects that had been in the tentative stage for considerable periods.

**Rails.**

It is estimated in competent circles that rail production in the United States in 1909 was not far from 2,500,000 tons as compared with 1,921,611 tons in 1908 and 3,633,654 tons in 1907. These comparisons fitly illustrate the rail buying activity of the railroads over the year, which was of only moderate proportions. The prospects for 1910 are reported to be much more promising, but the eastern makers at the end of 1909 had not booked heavily, as a number of the eastern lines had not entered the market for their full forward requirements. The Pittsburg mills on Jan. 1 were filled by actual orders booked for scarcely more than 50 per cent of their first half capacity. It is believed by some rail makers that the new capacity at Gary, Ind., and Ensley, Ala., will be wholly adequate to meet the demands in the western and southern sections where new construction is more active and that scarcely any occasion is likely to be presented of full outputs being rolled in the eastern plants. The principal rail order of the year was placed in September by the Pennsylvania system, and this called for estimated requirements for 1910 delivery of 200,360 tons. The Pennsylvania's requirement contract in 1909 was 135,600 tons.

**Sheets.**

Although at the close, sheets were one of the most active products in the entire industry, the full year sizes up as a period of only ordinary importance as to tonnage produced. During the depression, the manufacturing and jobbing trades had permitted their stocks to gradually decline and conducted new buying with caution. This policy was much in evidence during the first half. When the returning activity in general business lines became more assured, there was a rush to cover for requirements, and the mills were loaded up with business in which quick shipment injunctions were numerous. Stocks of blue annealed sheets in the country were especially low and this grade came into great demand. Deliveries fell back quickly and the general average time of shipment at the end of the year was fully three months. With the return of active conditions in the market, influential makers resumed their former policy of requiring fixed tonnages for stated periods to be taken out according to the strict letter of contracts. This course of procedure enabled these makers, through the definite prearrangement of mill schedules to handle the situation as to deliveries in a much more satisfactory manner than if the old method of optional specifying had been allowed. Sheet prices in the year were fairly constant, opening at 2.40c and 3.55c for No. 28 gage black and galvanized respectively, and closing at 2.40c and 3.50c. After the establishment of open conditions, the independent makers, at a meeting in Pittsburg, put the market upon a definite basis by announcing a fixed schedule of quotations. These semi-official prices were frequently subject to severe shading but there was a noticeable strengthening over the last half, and during the last quarter when successive advances were announced they were closely observed.

The operations of the American Sheet & Tin Plate Co. over the year averaged about 68 per cent of the total capacity of 186 hot mills. This average would have exceeded 70 per cent but for the strike of the Amalgamated Association of Iron, Steel and Tin Workers, which kept the large Aetna-Standard works at Bridgeport, O., in idleness over the last half and interrupted operations at several other plants. The average operations of the independent plants were slightly in excess of 80 per cent of the total active capacity. During the last half, these makers were enabled to run about 90 per cent of their full output. At the close of the year, the American

Sheet & Tin Plate Co. was operating 163 sheet mills or 88 per cent of total capacity.

### Tin Plate.

All indications point to the fact that the year 1909 has been the heaviest in tin plate consumption in history, and it is estimated that the output will be approximately 600,000 net tons as compared with 537,000 net tons in 1908 and 577,000 net tons in 1906, the previous high mark. Owing to the interruption of plant operations by the Amalgamated strike, the total shipments of the American Sheet & Tin Plate Co., were slightly less than those of the record year, but the independents were not affected in this respect and increased their outputs. By reason of the uses to which it is put, tin plate is a staple product, and its output, little affected by business depressions, has varied but a few per cent over recent years. Canning activity in 1909 was heavy. The fruit and vegetable canners enjoyed a splendid season due to the bountiful crops, while the pack of the Pacific coast salmon industries, an important source of tin plate consumption, was the largest ever known. Miscellaneous buyers also contracted freely. Tin plate prices were not subjected to much fluctuation and the final ruling quotation was $3.60 per base box as against $3.70 per box at the beginning of the year. Following the declaration of the open market tin plate prices were established at $3.45 in March and there was no change until the advances to $3.50 in October and to $3.60 in November. Before the rise in the market late in the year, some of the independent companies with their outputs heavily booked, asked premiums on quick shipment orders. The new year begins with a large increase of tin plate capacity in the Pittsburg district, as new construction lately completed or well advanced will add a total of 34 hot mills, divided into, 10 Jones & Laughlin at Aliquippa, Pa., eight Phillips Sheet & Tin Plate Co. at Weirton, W. Va., 10 McKeesport Tin Plate Co., at Port Vue, Pa., and six Standard Tin Plate Co., at Canonsburg, Pa.

### Merchant Pipe and Boiler Tubes.

Due to the comparatively low prices prevailing in the tubular market, the year has been a favorable one for activity in pipe line construction, and a large number of important projects were carried to a successful termination. It is believed that production in the year reached the highest point in history, being estimated at 2,200,000 net tons. The National Tube Co. was one of the first to fix a new level of prices in any finished line following the declaration of the open market, when it immediately announced a decisive reduction of $10 a ton on its discount cards. This cut was of such proportions that it had an early and salutary effect upon the market, and buyers soon began to enter their requirements. A large tonnage continued to come upon the market and all makers booked heavily and were enabled to maintain very full mill operations. With respect to tonnage entered, the year has been a good one for the mills, although some dissatisfaction has been expressed over the level of prices at which it was necessary to accept business. In their selling to the jobbing trade, makers pursued the policy of accepting specifications for not more than 30 days ahead, and this kept speculative buying within limits. The advance in steel pipe prices was very slow and at the beginning of 1910 they had reacted but $2 a ton from the low point of the year. During the same period iron pipe advanced $8 a ton. Among the important pipe line contracts placed were the following: 400 to 500 miles of 8-inch pipe divided among three independent mills for California delivery to oil interests connected with the Harriman railroad system; 125 miles of 16-inch pipe to the National Tube Co. by the Lone Star Gas Co. for a gas line from Petrolia to Fort Worth, Tex., and 110 miles of 12-inch and smaller sizes to Spang, Chalfant & Co., Inc., in connection with the same project; 90 miles of 18-inch pipe for a gas line from the West Virginia fields to the Sugar Grove, O., fields, by the Ohio Fuel Supply Co.; 60 miles of 16-inch for a gas line from Oklahoma to Joplin, Mo., by the Quopaw Gas Co., a Barnsdall interest; 60 miles of 16-inch for a gas line from the Kansas fields to Kansas City, Mo., by the United Gas Improvement Co.; 40 miles of 16-inch and 12 miles of 20-inch for the Pennsylvania fields by The Philadelphia Co. The Union Petroleum Co., of Buffalo, also took 60 miles of 8 and 10-inch pipe, but second-hand goods were used. Late in the year the Arkansas Natural Gas Co. brought out a proposed line in Arkansas which will require 100 miles of 16-inch and 180 miles of 6 and 8-inch. The Pure Oil Co. also had in contemplation a new line of 8-inch, 200 to 300 miles in length, for Illinois, and Standard Oil interests were planning a 200 to 300-mile gas line from West Virginia to Baltimore.

Until locomotive buying became more active and new power construction revived somewhat with better industrial conditions generally in the country, the boiler-tube market continued dull and orders were held to maintenance and to ordinary requirements. During the last half, however, there was a marked increase in new business, much of which was attributable to the larger contracting by the railroads, and makers filled their plants very comfortably. The National Tube Co. at the beginning of the year abandoned the manufacture of iron tubes and confined itself to the production of Spellerized steel tubes. Along with merchant pipe, tubes were reduced $10 a ton on base sizes early in the year. Several advances were posted during the last half and the market at the year end was two points or $4 a ton in iron and one point or $2 a ton in steel over the lowest point touched.

The official card discounts on the base sizes of steel merchant pipe 2-4 to 6 inches during the year 1909, were as follows:

| | |
|---|---|
| January-February | 75 off |
| February-October | 80 off |
| October-December | 79 off |

On iron pipe they were as follows:

| | |
|---|---|
| January-February | 73 off |
| February-July | 77 off |
| July-September | 75 off |
| September-November | 74 off |
| November-December | 73 off |

The official card discounts on iron and steel boiler tubes, base sizes 2¼ to 5 inches, were as follows:

| | Iron | Steel |
|---|---|---|
| January-February | 52 off | 65 off |
| February-October | 57 off | 70 off |
| October-December | 55 off | 69 off |

### Old Material.

Following the course of pig iron, the scrap market fluctuated considerably during the year, but over the last half its tone was strong and prices showed a continued advance. Heavy steel touched $18.50, No. 1 wrought $19.50 and No. 1 cast $17.50, delivered in the year. The low point was not as extreme as in 1908. There is a tendency not to be overlooked in the scrap market along the line of melters seeking to be independent of the dealers as far as possible in their buying. Direct contracting by steel makers with producers has become more extended, and an important development in the same direction is the method of associated buying adopted by leading consumers in the eastern district. While this plan of purchasing material would find ob-

stacles in the Pittsburg territory from the fact that the United States Steel Corporation, the largest consumer of the district, would probably not be a party to it, its adaptation to the local conditions is not at all unfeasible. With the greater efficiency of mill operations, it is also apparent that a smaller floating supply of material is being put upon the market by the steel industry itself. These developments of the market are making the position of the dealer less favorable and are tending toward the increase of the speculative factor in his buying.

### Labor Conditions.

Probably no year in the recent history of the iron and steel industry has been more fraught with important developments affecting labor than 1909. A continued dullness of business conditions in the first quarter of the year in connection with the low prices prevailing had provoked a general consideration by employers of wage reductions, and when the announcement of the lower tariff schedules proposed was made, a readjustment of labor costs was looked upon as inevitable. On April 1, a 10 per cent reduction applying to iron and steel mill, blast furnace and coke oven labor was posted by many important companies, including in the Pittsburg, Mahoning and Shenango valley districts the Jones & Laughlin Steel Co., Republic Iron & Steel Co., Shenango Furnace Co., Dunbar Furnace Co., and others. The rather abrupt recovery of strength by the iron and steel market soon after and a more temperate view of the tariff effects paved the way for a speedy restoration of the old wages, which was generally made by June 1. The mid-year expiration of annual scales was attended by developments of widespread moment. The establishment of the open shop in the plants of the American Sheet & Tin Plate Co., thereby precipitating a strike by the sheet and tin plate divisions of the Amalgamated Association of Iron, Steel and Tin Workers, which is still is progress, has been of notable significance, since it represents the effort at banishment of the last evidence of unionism from the mills of the United States Steel Corporation. Early in June, the company announced its purpose to adopt the open shop upon the expiration, July 1, of its annual scales with the Amalgamated Association. The declaration applied to nine tin plate plants with a combined capacity of 142 hot mills and four sheet plants with a capacity of 51 hot mills. The Amalgamated Association, at a delegate convention in Pittsburg, June 16, decided to oppose the policy. A similar position was taken by the Tin Plate Workers' International Protective Association of America, the tin house organization and the 14 union plants of the company were struck on July 1 by the Amalgamated Association, and on July 15 by the tin house employes. By importing new men and by winning back its old employes, the company has been enabled to gradually build up new organizations in its plants. Toward the close of the year it was operating 21 of its 44 serviceable union sheet and 83 of its 135 serviceable union tin plate mills, and was preparing to start several other plants. The Youngstown Sheet & Tube Co. also declined to sign the sheet scale with the Amalgamated Association and has operated its plant as an open shop despite the strike of the union. The La Belle Iron Works successfully resisted an attempt of the Amalgamated Association to organize its sheet plant. The position of the main body of independent sheet and tin plate makers operating union plants has remained unchanged, as at a conference at Pittsburg, June 29, a new agreement providing the same wage scale as the preceding year was signed, to remain in force to July 1, 1910.

Some delay attended the adoption of the annual iron boiling and finishing scales in June because the manufacturers had at first taken the position that a reduction would be necessary. Notice had been given in February that neither party would be bound this year by the continuous working agreement which provided the method of procedure where conciliation was necessary after the failure of annual conferences. The Amalgamated Association, at its convention in Detroit, adopted the preceding year's agreement as its convention scale, which it presented to the manufacturers. The first conferences with the manufacturers were unproductive of results, but an agreement was finally reached with the Western Bar Iron Association at Cambridge Springs, Pa., June 26, which left unchanged the boiling rate at $5 a ton upon a 1 cent bar iron card. The Sons of Vulcan signed with a number of the iron mills with an agreement of a $5.12½ boiling rate on a 1 cent card. The bi-monthly settlements in 1909 between the manufacturers and the Amalgamated Association, which are based upon the actual selling prices of bar iron, sheets and tin plate, were as follows:

| | Basing price. Per pound. | Boiling rate. per ton. |
|---|---|---|
| January-February | 1.30c | $5.25 |
| March-April | 1.35c | 5.37½ |
| May-June | 1.30c | 5.25 |
| July-August | 1.25c | 5.12½ |
| September-October | 1.35c | 5.37½ |
| November-December | 1.40c | 5.50 |

| | Sheets. 2.50c base. | Tin plate. $3.90 base. |
|---|---|---|
| January-February | base rates | base rates |
| March-April | base rates | base rates |
| May-June | base rates | base rates |
| July-August | base rates | base rates |
| September-October | base rates | base rates |
| November-December | base rates | base rates |

One of the most interesting as well as serious labor controversies of the year was the strike against the plant of the Pressed Steel Car Co., at McKees Rocks, Pa. A protest against some of the methods of payment and operation at the plant, and with some of the men a demand for the restoration of 1907 wages, precipitated the trouble, which came to a climax July 12, when about 5,000 unorganized employes struck their work. Though the strikers were made up of widely mixed nationalities, they succeeded in forming an effective organization, and for nine weeks a serious condition, in which bloodshed and riot occurred, prevailed in the mill town of Schoenville. In one of the outbreaks, where the strikers attacked the armed deputies and state constabulary patrolling the town, a number of persons were killed. Because of its unusual character, the strike attracted widespread attention and elicited some government inquiries. A settlement was finally brought about through a compromise in which certain modifications in the practiced systems were agreed to by the company and the demand of the men for a wage increase was not insisted upon under the prevailing business conditions. No further trouble has developed since the adjustment of the dispute, and the plant is now steadily operating.

## NEW CONSTRUCTION.

### Blast Furnaces.

(Non-Merchant.)

Aliquippa furnace No. 1, Aliquippa, Pa., Jones & Laughlin Steel Co., blown in in December; Nos. 2 and 3 nearing completion, to be in operation during first half; No. 4 furnace in preliminary stage.

Ohio furnaces Nos. 5 and 6, Youngstown, Carnegie Steel Co., completed and in blast.

Duquesne furnaces Nos. 5 and 6, Duquesne, Pa., Carnegie Steel Co., completed and in blast.

C furnace, Youngstown, Youngs-

town Sheet & Tube Co., under construction.

Haselton furnace No. 4, Youngstown, Republic Iron & Steel Co., under construction.

**Blast Furnaces.**

(Merchant.)

Anna furnace, Struthers, O., Struthers Furnace Co., rebuilt and blown in in November.

Stewart furnace, Sharpsville, Pa., Stewart Iron Co., rebuilt and blown in in December.

Hubbard furnaces, Hubbard, O., Andrews & Hitchcock Iron Co., one stack rebuilt and blown in; second stack under rebuilding.

Ella furnace, West Middlesex, Pa., Pickands, Mather & Co., rebuilt and blown in.

**Steel Works.**

Jones & Laughlin Steel Co.—Four Talbot continuous furnaces, 250 tons daily capacity each, completed, South Side plant; four Talbot furnaces building at new Aliquippa works.

Carnegie Steel Co.—Four 60-ton basic open-hearth furnaces building at Homestead works; 12 60-ton basic open-hearth furnaces completed at Ohio works, Youngstown; 12 60-ton basic open-hearth furnaces completed at Duquesne works.

National Tube Co.—Six 60-ton open-hearth furnaces completed at Lorain, O., works.

Forged Steel Wheel Co.—Six 60-ton open-hearth furnaces under construction at Butler, Pa.

West Penn Steel Co.—One 80-ton basic open-hearth furnace completed at Brackenridge, Pa.

Page Woven Wire Fence Co.—One 50-ton basic open-hearth furnace completed at Monessen, Pa.

Sharon Steel Hoop Co.—One 50-ton open-hearth furnace building at Sharon, Pa.; will be fired in January.

Allegheny Steel Co.—One 50-ton open-hearth furnace completed; one furnace rebuilt to 50-ton capacity.

Republic Iron & Steel Co.—Six 60-ton basic open-hearth furnaces under construction at Lansingville, O., near Youngstown.

**Sheet Mills.**

West Penn Steel Co., Brackenridge, Pa., three mills completed and in operation; fourth being added.

DeForest Sheet & Tin Plate Co., Niles, O., new plant of two mills completed and in operation.

Empire Iron & Steel Co., Niles, O., two additional mills building.

Thomas Steel Co., Niles, O., five additional mills building.

Youngstown Sheet & Tube Co., Youngstown, O., eight additional mills building; will be started in January or February.

**Tin Plate Mills.**

McKeesport Tin Plate Co., Port Vue, Pa., 10 additional mills being installed, making plant capacity of 20 mills.

Jones & Laughlin Steel Co., new 10-mill plant building at Aliquippa, Pa.; will be completed in the spring.

Standard Tin Plate Co., Canonsburg, Pa., six mills added, making plant capacity of 10 mills.

Phillips Sheet & Tin Plate Co., Wierton, W. Va., eight mills under construction; will be completed early in the year. Company also operates twelve-mill plant at Clarksburg, W. Va.

DeForest Sheet & Tin Plate Co., Niles, O., new plant of four mills erected and in operation.

**Tube Works.**

Haselton Steel Tube Co., subsidiary of Republic Iron & Steel Co., four-furnace plant under construction at Haselton, O., will be completed during first quarter.

Central Tube Co., Pittsburg, merchant pipe plant installed at Economy, Pa.

National Tube Co., 18 welding furnaces completed at McKeesport works; installing two butt-weld furnaces at Lorain, O., works to be completed by spring.

Spang, Chalfant & Co., Inc., three welding furnaces rebuilt; another furnace being rebuilt at Aetna, Pa., works.

A. M. Byers Co., two heating furnaces completed and operating at Girard, O., in connection with new iron plant of 42 single puddling furnaces.

**Other Finishing Mills.**

Carnegie Steel Co., installing new 22-inch structural mill at Clairton, Pa., plant; equipment installed in Edgar Thomson works for manufacture of Slick steel wheel.

Forged Steel Wheel Co., subsidiary of Standard Steel Car Co., building new slabbing mill at Butler, Pa.

National Tube Co., installing 14-inch skelp mill at Lorain, O., plant; will be ready for operation in spring.

Sharon Steel Hoop Co., 14-inch breaking down mill installed at Sharon, Pa., plant.

Jones & Laughlin Steel Co., new continuous billet mill and additional merchant bar mill installed at South Side works, Pittsburg; billet and sheet bar, wire and wire rod mills building at Aliquippa, Pa.; billet and sheet bar mills to be in operation about mid-year.

Republic Iron & Steel Co., blooming, billet and sheet bar mills under construction at Lansingville, O., near Youngstown.

**Projected Construction.**

Carnegie Steel Co.—Additional merchant mills with eventual capacity of 60,000 to 65,000 tons monthly, to be built near Girard, O.; first unit to contain six mills.

Basic Steel Co.—New open-hearth steel works at Niles, O.

## NEW FOUNDRY AT RACINE.

The Racine Foundry Co., of Racine, Wis., has filed articles of incorporation. The capital stock is $40,000 and the incorporators are H. E. Graham, R. P. Birdsall and W. C. Palmer. The company will make automobile castings of iron, brass and aluminum a feature. It has commenced operating in the Ehlholm property on Tenth street. The former Chalmers foundry on Eleventh street has been added to the plant. Work will be commenced immediately on the erection of these buildings: Foundry, 60 x 125 feet; boiler shop, 30 x 100 feet; machine shop, 40 x 100 feet.

## NEW STOCK SOLD.

The new stock of the McCrum-Howell Co., radiators, etc., incorporated under the laws of Connecticut, has been sold, it has been announced. The company recently increased its preferred and common stock each from $600,000 to $1,500,000. The $900,000 of new preferred was sold at $100 and each share carried with it a bonus of 20 per cent of the common. Both classes of stock are to be listed on the Chicago stock exchange this month, the application now being in the hands of the exchange governors.

## BUILDING AN ADDITION.

The Dayton Brass Foundry, located at 916 East Third street, Dayton, O., manufacturer of bearing metal for street cars and railroads, is erecting an addition to its plant which will enable it to double its capacity in turning out its largely increasing product.

The Georges Creek Coal & Iron Co., Baltimore, has declared the semi-annual dividend of $2.50 per share, free of taxes, payable after Jan. 4.

# SPLENDID RECOVERY IN THE CHICAGO DISTRICT

## STORY OF PROGRESS FROM STAGNATION TO GREAT PROSPERITY

### Unparalleled Production and Consumption in the Western Territory—Unsettled Conditions Followed by Liberal Buying and Great Activity of Blast Furnaces and Mills.

By James F. Pendleton.

"Like a giant refreshed with wine," the iron and steel business has arisen from a period of acute depression to a condition of prosperity and splendid achievement unequalled in the world's commercial history.

At the beginning of the year, the effects of over a twelve-month of depression were just beginning to wear off, and the patient was in a very precarious state, every little symptom which showed improvement and seemed to indicate any approach toward convalescence being hailed with relief.

The process of recovery was a gradual one, at first, and several months dragged along before anything like normal business conditions were reached, but when the improvement once set in, it came with an on-rush that was irresistible.

The history of our commercial life in the years 1908 and 1909 is only typical of the splendid American spirit which just begins to fight when the battle seems lost, and which never was better exemplified than in the disastrous experiences of Chicago, Charleston, Galveston and San Francisco. So it has been in all panics, and it was particularly true of the one which was precipitated in the fall of 1907. After a season of unnatural expansion and inflation, there came the day of settlement, and industrial establishments found it necessary to come to a complete stand-still, until they could get their bearings and until some of the wreckage of the crash had been cleared away.

The period of inaction, however, was well employed in most instances, in putting manufacturing plants in first class condition to meet the heavy demand which the manufacturers' optimistic spirit compelled them to believe would come, after a little patient waiting. That great wisdom was shown in this overhauling and rehabilitation of plants, has been demonstrated in the recent magnificent and unprecedented records of production, which were made all over the country.

The exceptional demand for labor developed instances of real hardship, where industries actually were crippled by a lack of sufficient men to run their plants to full capacity, and at a rate commensurate with the business in sight. The phenomenal growth of the automobile industry was productive of peculiar conditions in several lines. Manufacturers of automobiles bought enormous quantities of shafting, tool steel, and other forms of steel, and their purchases of high-grade machinery and machine tools literally stripped the market of these products, until delivery of many kinds of machinery became a question of several months. Skilled labor, especially machinists, found such lucrative employment in automobile shops that the regular jobbing machine shops found it a difficult matter to secure employes.

**Long Time Contracts Abolished.**

At the outset of the improvement in trade conditions, manufacturers of iron and steel adopted a conservative policy in their sales departments, and the "long distance" buying, which, in the past, had proven nothing more than an option, to be cancelled by the purchaser at will, was done away with, to a great extent. Contracts running over a long period, with no sliding-scale arrangement as to prices, have become rare, and this policy of conservatism eventually will work a benefit alike to both buyer and seller. During the latter months of 1909, manufacturers, wtih very little trouble, could have sold their entire product for the coming year, if they had been willing to lose sight of the advantage of the higher prices which 1910 undoubtedly will bring, and to take chances on the possibility of cancellations.

The congested conditions which soon existed in the mills as a result of the wave of prosperity, making it a physical impossibility to maintain deliveries even remotely approximating promptness, produced a situation which became a veritable harvest-time for the large warehouses, which had accumulated immense stocks of bars, shapes and all forms of iron and steel. In some cases, these store stocks were the largest in the history of the jobbers carrying them. When the forward movement got into full swing, and deliveries from mill fell further and further behind, consumers were forced to turn to jobbers for their more pressing requirements. This demand on the warehouses finally grew to such dimensions that deliveries out of store, especially of structurals, to be cut to length, could not be made in a week, or a longer time than shipments from mill would have required, only two or three months earlier in the year.

**Pig Iron Fluctuations.**

The pig iron industry had the usual fluctuating experiences, both as to prices and production. The latter reached, in October, a point never before approached, and the year closed with the furnaces producing at a

**Average Monthly Prices (Minimum), Chicago Delivery, 1909.**

| | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lake Superior Charcoal | $19.50 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 | $19.69 |
| Northern No. 2 Foundry | 17.69 | 16.75 | 16.50 | 16.46 | 16.21 | 16.41 | 16.90 | 17.38 | 18.20 | 18.88 | 19.00 | 19.00 |
| Southern No. 2 Foundry | 17.29 | 16.98 | 16.10 | 15.55 | 15.85 | 15.85 | 16.75 | 17.60 | 18.25 | 19.35 | 19.23 | 18.60 |
| Bar Iron | 1.50 | 1.48 | 1.40 | 1.29 | 1.25 | 1.30 | 1.35 | 1.40 | 1.47 | 1.50 | 1.56 | 1.60 |
| Soft Steel Bars | 1.58 | 1.52 | 1.35 | 1.35 | 1.35 | 1.35 | 1.42 | 1.48 | 1.56 | 1.58 | 1.63 | 1.68 |
| Structural Steel (Beams) | 1.78 | 1.70 | 1.48 | 1.45 | 1.43 | 1.46 | 1.52 | 1.59 | 1.68 | 1.68 | 1.78 | 1.78 |
| Plates | 1.78 | 1.71 | 1.48 | 1.43 | 1.45 | 1.43 | 1.50 | 1.58 | 1.64 | 1.68 | 1.78 | 1.78 |
| Sheets, No. 28, Black, ex. store | 2.85 | 2.85 | 2.75 | 2.75 | 2.75 | 2.75 | 2.75 | 2.75 | 2.75 | 2.90 | 2.95 | 2.95 |
| Sheets, No. 28, Galvanized, ex. store | 3.90 | 3.90 | 3.80 | 3.80 | 3.80 | 3.80 | 3.80 | 3.80 | 3.80 | 3.90 | 4.00 | 4.00 |
| Plain Wire, C. L., to Jobbers | 1.98 | 1.98 | 1.98 | 2.00 | 1.63 | 1.68 | 1 70 | 1.78 | 1.78 | 1.78 | 1.78 | 1.81 |
| Wire Nails, C. L., to Jobbers | 2.16 | 2.13 | 2.09 | 2.13 | 1.83 | 1.88 | 1.90 | 1.98 | 1.98 | 1.98 | 1.98 | 2.01 |
| No. 1 R. R. Wrought Scrap | 13.75 | 13.00 | 11.56 | 11.85 | 12.81 | 13.69 | 13.30 | 14.56 | 15.35 | 15.81 | 15.06 | 14.50 |
| Heavy Melting Steel | 14.00 | 13.38 | 12.13 | 12.87 | 13.50 | 14.13 | 14.05 | 14.94 | 15.80 | 16.31 | 15.75 | 15.50 |
| Old Iron Rails | 18.88 | 18.25 | 16.88 | 16.15 | 16.88 | 17.44 | 17.00 | 18.44 | 19.35 | 20.50 | 20.25 | 19.50 |
| Re-rolling Rails | 15.81 | 15.06 | 12.81 | 13.20 | 14.63 | 15.50 | 15.55 | 16.00 | 17.20 | 18.00 | 20.25 | 17.70 |

very high rate. Prices of foundry iron, in the Chicago market, at the opening of 1909, were almost as high as the highest point in 1908, and about one dollar above the low point of that year. During the first two months of last year, however, it became evident that the previous year's contracts were much heavier than the melters' requirements, and the market became unsettled, drooping, stagnant. Conditions in March were so discouraging, that a number of furnace interests were inclined to shut down their plants. Low tide in southern foundry iron prices was reached at Chicago in April, when a few sales were made on a basis of $10.50 and $11.00, Birmingham, or $14.85 and $15.33, Chicago. Northern foundry at Chicago reached its low point in May and June, with sales at a minimum price of $16.15.

About the first of April, a buying movement was inaugurated, when sales of 50,000 to 60,000 tons of foundry iron were made by the Steel Corporation interests, at a price around $11.00, Birmingham, for delivery during the latter half of 1909. By the first of July, there could be no doubt about the market's firmness and gain in strength, which continued from week to week, until, in September, the furnaces assumed a very indifferent attitude as to sales, and consumers began to grow anxious, having at last realized that a strong forward movement was in progress. Early in August, the first signs of inconvenience from car shortage began to be felt, but serious famine conditions were not reached during the remainder of the year, although the demand for rolling stock for the movement of coke, pig iron, and finished material, as well as the tremendous crops, was very heavy.

### Tremendous Production.

All records of pig iron production were left in the background, in October, when the coke and anthracite furnaces of the country were producing at the rate of over 31,000,000 tons annually, and in November the daily average was even larger than in October. Sales of pig iron also outstripped all previous records in that month, and prices for foundry irons at Chicago reached their high point for the year. Lake Superior charcoal iron was held at practically the same level throughout the year, but in October the makers announced an advance of a half-dollar for the first quarter, and a dollar a ton for the second quarter of 1910, the price of $19.50, Chicago, remaining in force for the remainder of the year.

Consumption of pig iron was maintained at a heavy rate during the latter half of the year, both by gray and malleable iron foundries, and this consumption would have been much greater but for the scarcity of labor in foundry plants, especially during the summer months.

When November was reached, the pig iron industry was confronted by the inevitable condition—consumers' requirements apparently provided for, and furnace capacity not entirely sold up. Sales fell off very sharply during that month, and the feeling, especially in the south, became weak, and a tendency to make concessions developed. A quantity of speculative iron, which had been held for a long time, came on to the market, and the efforts of holders to unload were so insistent, that the price for spot iron weakened, and after a few weeks of quiet, in which the market lacked support, the price for first quarter delivery became affected. Added to the pressure of the resale iron, was the effect of a few furnaces blowing in, without any orders on their books, which did not help the situation. The close of the year found southern iron still in a weak condition, but most of the northern furnaces were making few, if any, concessions.

During the year, a number of furnaces made improvements in equipment, which increased their capacity, and all but two of the eight new Gary furnaces were in blast at the end of the year, so that the pig iron producing capacity of the Chicago district was well employed when 1910 was ushered in.

### Crude Steel.

Billets, at the opening of the year, were selling at $26.50 and $28.50, Chicago, for rolling and forging billets, respectively, which price prevailed, nominally, until the general lowering of prices in February. There are but few makers of billets in the Chicago territory, most of whom consume their entire product in their own mills, the surplus product being sold under long contracts to regular customers. For this reason, there has been no billet market in Chicago for several months. Consumers who had no running agreement with local mills have been compelled to look to eastern mills for their supply of billets, and the price has depended largely upon the needs of the buyer and the scarcity of the steel.

The event of the year, in this branch of the local steel business, was the completion and operation of the Indiana Steel Co.'s billet mill, at Gary, Ind., which was illustrated and described in THE IRON TRADE REVIEW, of Oct. 21. The starting of this mill apparently has not relieved the famine in the billet market in the west, as the product of the mill has been consumed, very largely, in the works of the Steel Corporation's subsidiary companies, within economical reach of Gary.

### Iron and Steel Bars.

Merchant steel pursued a rather lifeless course for several weeks in the new year, but, with the abandoning of the price maintenance policy, in February an era of lower prices set in, and from 1.50c and 1.58c, base, for iron and steel bars, respectively, at the opening of the year, prices ran down to 1.25c in April and May. This low price induced heavy buying, and contracts for large tonnages were made, for the rest of the year. Before the rush began, or early in April, shipments from mill were so prompt that jobbers reduced their prices $2.00 per ton, in order to make store business more attractive.

During the year, several causes contributed to the expansion of business in bar iron and steel; one of these was the very heavy increase in re-enforced concrete construction, calling for a tonnage in twisted bars, which in itself has become a very important factor in the steel business. From this source, the demand certainly will increase, as concrete construction becomes more generally introduced. Another influence was the increasing use of the all-steel and steel-underframe car by the railroads. The number of steel cars purchased during 1909 reached a very large total, and the steel entering into their fabrication amounted to hundreds of thousands of tons. A third cause of increased consumption of steel was the phenomenal increase in the automobile business, which made such inroads on the supply of shafting that some sizes practically were cleaned up. This industry may be looked upon as a permanent one, and in the future will be a large consumer of merchant and tool steel, and high grade machinery and tools.

A new classification of extras on steel bars and shapes was announced under date of Sept. 1 by the Carnegie Steel Co. The new card differs from the former classification in that the extras shown are all net and that the list is one-half the extras of the old list, the purpose being to quote a base price plus net extras. A further

change is the including in the extras for angles, channels and tees, $2 per ton over that formerly asked on base bars, and $3 a ton differential on hexagons. The net result of the change is that extras are advanced on 5/16-inch and ¼-inch rounds, small angles and tees, etc., and a reduction on hexagons. An itemized list of the changes was published in THE IRON TRADE REVIEW of Sept. 16.

### Gary Merchant Mill Starts.

An important addition to the producing side of the merchant steel business in local territory, was made when the first train of rolls—the 18-inch in the Indiana Steel Co.'s merchant mill, at Gary, was started in December, the first steel being rolled, experimentally, on the 16th. Good progress is being made on the other mills, and by early spring, the entire five trains probably will be rolling merchant steel. The axle mill is making satisfactory headway, and will not be many months in getting into operation. Bar iron production was given additional impetus by the starting of the Blue Island Car & Equipment Co.'s 14-inch and 18-inch mills; the same company is putting in a 20-inch mill. Important additions are being made to the equipment of the Interstate Iron & Steel Co.'s plant, at East Chicago, where a complete 22-inch bar mill is under construction.

### Structural Shapes.

Structural material followed the same course as bars, in the early months of the year, sharing in the unsettled conditions which led up to and followed the declaration of an open market, in February, and which resulted in the placing of heavy orders by jobbers and fabricating plants. The year was remarkable for the large number of building projects undertaken, as well as bridges, track elevation and subway construction. Gradually the market steadied, and the mills filled up with orders, so that, by early June, there began to be felt the first inconvenience from delayed deliveries, which condition grew steadily worse, until, at the end of the year, the structural mills found themselves at least six months in arrears in getting out orders.

At the close of the first half of the year,—so rapid had been the recovery—contracts for 650,000 tons of fabricated material had been placed, in a comparatively few weeks, or nearly one half the annual capacity of the fabricating plants, which was, at that time, 1,500,000 tons. This condition naturally had a very radical effect on prices of fabricated material, which, by Aug. 1, had advanced $10 per ton over the low point of the year. Important developments in this department in the Chicago territory were the beginning of work on the American Bridge Co.'s large plant at Gary, and the decision of the McClintic-Marshall Cnstruction Co. to build a plant at Indiana Harbor, both of which will add very largely to the output of structural material in this district.

### Plate Business Heavy.

After the settling process had accomplished its work, following the horizontal reduction in prices, the plate market made good recovery and large bookings were entered, although manufacturers steered a safe course in adhering to their conservative policy, in this, as in other lines, of confining sales to near-by delivery, or at least to the current year. Some uncertainty was felt as to the probable action of congress on the tariff question until that measure finally received the president's signature. An important mile-stone was passed when the Illinois Steel Co., about July 1, ceased to quote plates on the basis of Pittsburg prices plus freight to Chicago, and established its quotations on the basis of Chicago delivery. Local production had a potential gain when work on the new plate mill at Gary was begun.

### Competition in Sheets.

The local production of sheets is not yet large enough to make Chicago a basing point for this commodity, and these quotations still are based on Pittsburg prices, freight to Chicago being added. During the initial months of the year, eastern competition was severely felt; because of the low rates by water to Texas common points, enjoyed by eastern mills. In common with other products, a reduction was made in mill prices on sheets, amounting to $4 per ton. The general improvement in business which set in a few weeks later, was felt very strongly in this line, and purchasing continued to be very active for several months. The one sheet manufacturer in the Chicago district—the Inland Steel Co., was encouraged to proceed with its program of expansion, and work has been progressing on the eight sheet mills, two open-hearth furnaces, and five galvanizing pots, all the above being additional to the company's previous equipment. Also, changes were made in the blooming and sheet bar mill, which resulted in increased capacity. An important announcement was made, last month, by the American Sheet & Tin Plate Co., that it would begin, at once, at Gary, the expenditure of $4,500,000, for the construction of a part of the extensive plate, jobbing and sheet mills announced earlier in the year.

### Rails and Track Supplies.

Comparatively little beyond routine selling of rails and track supplies was done in the first half of the year. In the middle of August, the Steel Corporation opened its books for the sale of steel rails for 1910, the initial contracts being with the Chicago & Northwestern for 60,000 tons, and with the Santa Fe for 145,000 tons. From that time, the sales were unusually heavy, and the local interest booked a large proportion of the total. Rail joints, spikes, bolts, and other track supplies figured very largely in the purchases made by railroads. The completion and starting up of the Indiana Steel Co.'s rail mill at Gary was an event of first importance. This mill was illustrated and described in THE IRON TRADE REVIEW of April 1, 1909.

### Wire Products.

The history of the local trade in wire products for the past year contains nothing of very great moment. The aggressive policy of independent wire manufacturers, of booking business at lower prices than those named by the leading interest, resulted, at the beginning of May, in a very radical price reduction by the latter, of from $7 to $10 per ton, on business other than that covered by contracts; a slow but only partial recovery has since been made. This line also suffered from the competition for Texas business made possible for a while, early in the year, by the low water rates from eastern territory to Texas common points.

### Tubular Products.

Merchant pipe and boiler tubes never figure very largely in the news features of the Chicago market. Chicago is only a distributing point, and does not participate in the heavier business which is done through the Pittsburg and other eastern sales offices, in the way of contracts for oil and natural gas pipe lines and their extensions. Discounts showed comparatively slight changes throughout the year. Warehouse business, in both merchant pipe and boiler tubes, was very heavy in 1909.

The cast iron pipe trade presented no unusual features during the year. A very good business was handled in the Chicago territory, with gas companies and municipalities, lettings of contracts by the latter being numerous and heavy. Prices made some advance in sympathy with the rise in pig iron, but not in full proportion. The year closed with a confident expectation of a large business in 1910.

### Old Material.

The old material market experienced a prosperous year, on the whole. Dealers in that line had some hard knocks about two years ago, when they were compelled to sell, if at all, at prices which meant heavy losses. Since that time they have been less eager to make sales and have accumulated large stocks, evidently determined to hold them until higher prices prevailed. As a result values in old materials have steadily advanced, week after week, with none of the usual temporary recessions, until attractive prices were ruling, and at these prices dealers were able to dispose of their stocks to good advantage and to recoup some of the losses they previously had suffered. The latter part of the year saw a somewhat weakened market, as consumers were well stocked up, and buying became very perfunctory. Prices sagged off somewhat, but no bad break occurred.

### New Construction.

The most important feature in the new construction in local plants was, of course, the large amount of work done at the Gary plant of the Indiana Steel Co. Six of the eight blast furnaces were completed, as well as the open-hearth plant; also the rail and billet mills. The merchant mill and axle mill made good progress, the 18-inch train of the former being put in operation near the close of the year. On the plate mill, also, considerable work was done, but it will be some months before that department will be in operation.

The extensive plant of by-product coke ovens of the Koppers type made good headway, a large part of the foundation work being in at the close of the year.

The American Bridge Co. began operations on its plant towards the close of the year, and the American Sheet & Tin Plate Co. announced in December that it would at once begin the expenditure of $4,500,000 on a portion of its projected plant.

A number of interests outside of the Steel Corporation have bought property in the town of Gary, and the first one to begin building operations probably will be the Pittsburg Bolt & Screw Co., which recently decided to erect a plant in that town.

The Illinois Steel Co., at its South Chicago plant, is building a new structural mill, which will not be completed before next summer.

The Interstate Steel Co. at East Chicago is erecting a new 22-inch bar mill.

The Blue Island Car & Equipment Co. has completed and put in operation its 14-inch and 18-inch bar mill, and is building a 20-inch mill.

The Inter-Ocean Steel Co. has near completion at Chicago Heights a plant for the making of locomotive and car wheel tires, and later other products probably will be added.

The Inland Steel Co., Indiana Harbor, has under construction eight new sheet mills, five additional galvanizing pots, and two open-hearth furnaces. In addition to the above, this company has completed a large warehouse for sheets which is one of the largest in the country, and has made changes in its blooming and sheet bar mill which has increased the capacity of the same.

The Pullman Co. during the year began the erection of a complete plant for the building of freight cars, which is still in process of construction.

The Simonds Mfg. Co. added to its equipment a two-high 20 x 32-inch hot finishing mill.

### Promising Prospects.

The year 1910 opens with most promising prospects for the iron and steel business, although at the close of last year pig iron, especially the southern foundry grades, was in a very weak state. The best authorities believe that it will take but a very few weeks to shake out all the weak holders of speculative and other re-sale iron, and that an active buying movement will set in and bring about a re-adjustment of prices on a higher plane, which will re-establish the $15, Birmingham, price on No. 2 foundry, if it does not carry the price beyond that point. All classes of finished material are in a very strong condition as the year opens, and nothing can be seen at present which possibly can prevent a continuance of the splendid conditions which prevailed during a large part of 1909, unless it be that a serious wage dispute should arise, in which case, of course, it is impossible to forecast how badly demoralized the iron and steel business might become. Barring any interruption to business from this source, it is the fixed and almost unanimous expectation among well posted authorities that the coming year will establish new records of production and of profits. This applies not only to raw material and semi-finished material, but goes all through the line and includes machinery, the makers of which are counting upon the best business in their history during the next 12 months.

## CHINESE PIG IRON.

### Efforts Being Made for Importation as Ballast for Tea Ships.

If present plans are successful, advantage will be taken of the assured high prices of pig iron on the Atlantic seaboard during the coming year to bring over a round tonnage of Chinese pig iron, on which low freights can be secured by employing it as ballast for tea boats. Recently some representative pig iron interests have been approached with the suggestion that they undertake the handling of this iron, and it is known that in one instance the matter was gone into thoroughly, although the proposition was finally rejected. It will be surprising if the coming year does not witness the importation of considerable iron from the Hang Yang works, where seven or eight moderate size blast furnaces are operating.

The shipment of Chinese iron to New York is by no means a new thing, though so far the movement has been so limited as to make it little more than a novelty. During the last boom period, one full cargo of this iron was brought over and sold on favorable terms, finding favor with the purchasers. Another cargo was started, but was delayed en route and finally reached its destination after the sharp decline had set in. As a result, the bulk of this iron was placed in storage and held until the rush of buying last fall, when a considerable part of it was sold. The remainder is still in the warehouse.

The Chinese iron is of such an analysis as to adapt it admirably to American consumption. Both basic and foundry iron is made, both running low in phosphorus, generally about 0.02, and the average sulphur content is about 0.03. In other particulars, it is a desirable iron, but local interests are slow to take up the handling of it for the reason that during the four months required for a cargo to reach this coast, radical price changes may have occurred in the domestic market, resulting in heavy losses.

# EMINENT MEN OF THE IRON WORLD

## XI—George Brooke.

By B. S. Stephenson.

There is a tradition in the iron industry that it makes for longevity. For proof of this one naturally turns to Eastern Pennsylvania, where the list of the grand old men of iron and steel-making who have lived and worked far beyond the accustomed bounds of time is indeed convincing.

But even among these pioneers of the industry, it has been given to few men to witness and participate in its development over such a remarkable span of years as to George Brooke, now nearing his ninety-second milestone. For practically three-quarters of a century—to be exact, seventy-three years next April—he has planned and guided the upbuilding of the varied works at Birdsboro, Pa., for most of that period, with his brother, in full and active control, and latterly, although yielding the management to a younger generation, a regular daily visitor at the offices and maintaining a complete acquaintance with all the more important features of the business.

What these seventy-three years have accomplished in the iron and steel trade is strikingly shown by contrasting the primitive charcoal stack at Hopewell, supplying the needs of two small forges, with the No. 3 blast furnace, now practically rebuilt on the most modern lines and operating in connection with the Gayley dry air blast, near which is another furnace, a cutnail factory, with an annual capacity of 250,000 kegs, and a great steel foundry. The open-hearth furnaces which serve the foundry evidence the progress in that direction of steel-making, and the shifting of the sources of ore supply—first from the neighboring hills to the rich magnetites of the Port Henry district and the deposits of the Lake Superior ranges and, more recently, in part to the trans-Atlantic fields, Spain and Sweden, and to the submarine workings off Newfoundland—is but another of the many interesting developments within the business activity of this man.

The Brooke family is one of the oldest among the many historic families of Eastern Pennsylvania. It was established in this country in 1698, when John and his wife, Frances Brooke, members of the Society of Friends, left Yorkshire, England, for the colony which William Penn had founded. From that old colonist himself, John Brooke brought a blanket title to 2,500 acres of land wherever it might please his fancy to settle between the Susquehanna and Delaware rivers, but the parents died soon after landing and their sons, James and Matthew, selected a tract of land in what is now Montgomery county, Pa. This Matthew Brooke was the first of three generations to bear that name and his grandson was the father of Edward and George Brooke. He entered the Colonial forces in the Revolution while scarcely more than a boy and suffered the hardships common to the Continental soldiers, among them that of being a British prisoner. Some time after the close of the war he left the original home in Montgomery county to locate on a farm which he purchased at Birdsboro, and for almost a century and a quarter the family has been identified in a most intimate way with the growth and industrial progress of that district.

The Brookes have been iron makers for over one hundred years. Matthew Brooke was a man of unusual business energy and had resided in Berks county only a few years when, with his brother Thomas and his brother-in-law, Daniel Buckley, he purchased the Hopewell furnace. This primitive stack had been built about forty years before by William Bird and was located some five miles from the village. During the years preceding the Revolution, this industry had flourished and had been extended by an addition of a rolling mill, a slitting mill and a nail factory. The charcoal requirements of these works were considerable and in order to insure an ample supply, land warrants for over 8,000 acres were taken out. In this connection it is interesting to note that, although charcoal long since ceased to play a part in the manufacturing activities of Birdsboro, the bulk of this acreage is still included in the Brooke holdings, which now aggregate 5,000 acres.

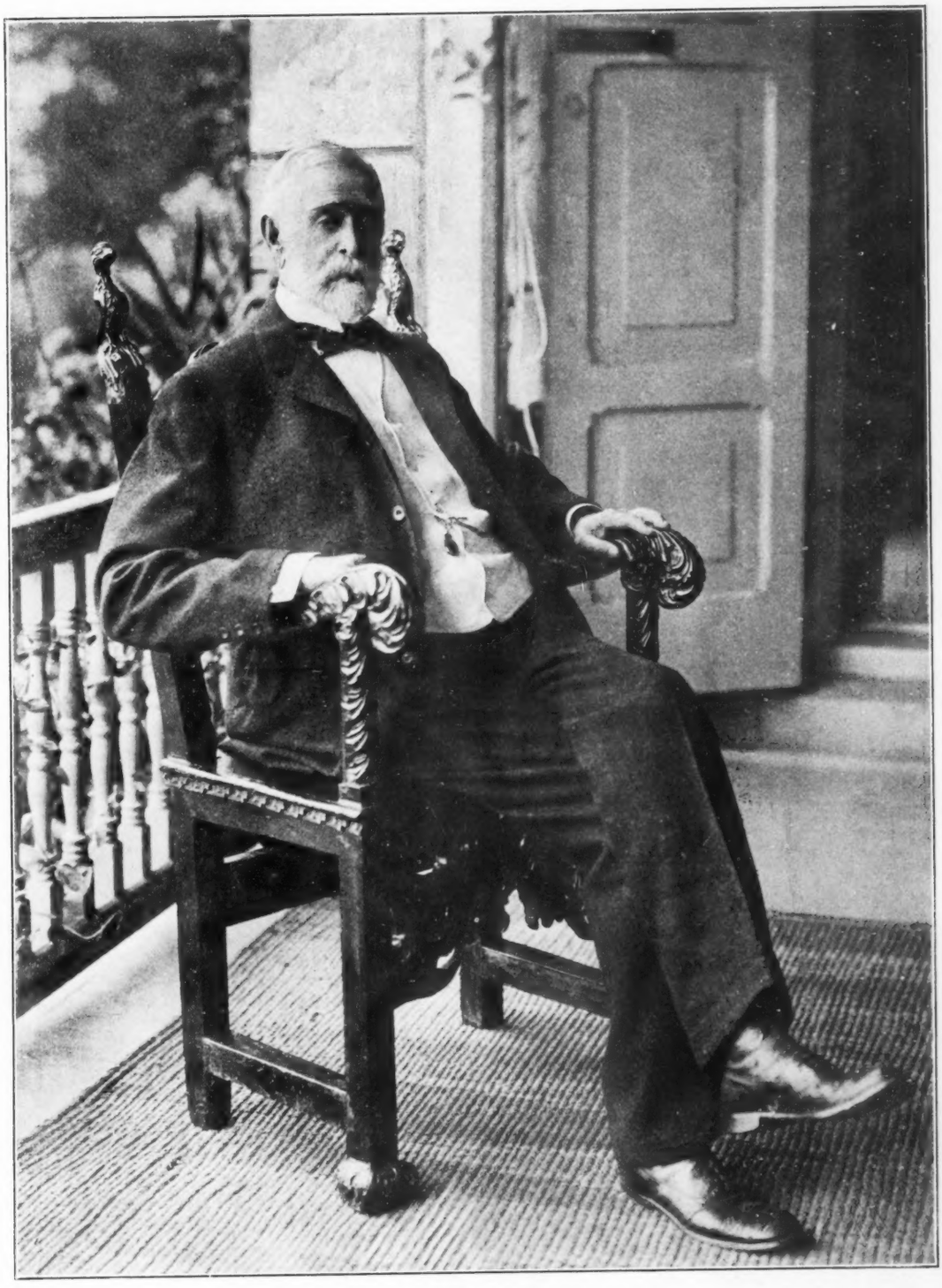
Soon after the Revolution, William Bird failed, as a result of which his properties were sold in 1786. A couple of years later the forges were leased to Captain John Lewis Barde, by whom they were operated successfully until 1796, when he purchased them, together with about 2,200 acres of land. Captain Barde was a native of Switzerland, who had been educated in England and had come to America with the British army sent to resist the Spanish operations at Pensacola, only to give up his commission and become a citizen of the United States, after having married the daughter of the English governor of West Florida. His daughter, Elizabeth, became the wife of Matthew Brooke, to whom these forges and land holdings passed on his death in 1799, and these, with the Hopewell furnace, formed the beginnings of the iron manufacturing industries for which Birdsboro has long been noted.

George Brooke was born at Birdsboro July 26, 1818. Both he and his brother, Edward, were quite young at the time of their father's death, and the iron works were leased while their education was being completed. On April 1, 1837, when Edward had just passed his majority and George was almost nineteen, they took over the management of the properties, which then included two forges, with an annual output of about 200 tons. Most of this product was disposed of in the form of bar iron and saw plates, principally the latter. The process then prevailing was to treat the pig iron first in the "refinery," thereby converting it into anconies, which were a form of bloom drawn or hammered down at one end into a bar for convenience in handling; these anconies were reheated in what was known as the "chafery" forge and were then hammered into finished shape.

At the outset the brothers adopted the name of E. & G. Brooke, and the business was continued as a firm until after the death of Edward Brooke on Christmas day, 1878, when the various interests were incorporated into two companies, the E. & G. Brooke Iron Co. and the E. & G. Brooke Land Co. From the beginning the business was uniformly successful. As it expanded and formed the industrial support of a growing community, its interests were naturally widespread, one of the first additions to the works being a large flouring mill, which was remodelled and enlarged several times.

The growing demands of the iron business early necessitated a furnace of improved type and in 1846, on the site of the old Hampton forge, a small charcoal

*Other biographical sketches in this series are as follows: 1. John Fritz, Feb. 28, 1907; 2. Joseph Wharton, April 4, 1907; 3. Frank J. Hearne, July 4, 1907; 4. Hugh Bell, Aug. 8, 1907; 5 John J. Spearman, Sept. 5, 1907; 6. James M. Swank, Jan. 2, 1908; 7. Sir Alfred Hickman, Feb. 6, 1908; 8. Powell Stackhouse, May 14, 1908; 9. Jos. Sellwood, June 18, 1908; 10. James Gayley, Jan. 7, 1909.



GEORGE BROOKE

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furnace was erected. This had the square stone stack characteristic of those days and was built into the side of a wooded hill for convenience in charging. The district was of remarkable beauty, and one of the most treasured possessions in the Brooke home today is a large painting of this little furnace and its forest clad surroundings, by a rather well-known artist of a half century ago. In 1852 an anthracite furnace was erected and continued in operation for a considerable term of years. Both these stacks, however, were dismantled long ago and practically nothing remains today to indicate their location.

The two furnaces which formed the nucleus of the present plant were built within the limits of the borough in 1871 and 1873, being designated as No. 2 and No. 3. One of these is still being operated somewhat in its original form, though, of course, with improvements added from time to time, and the other is now being practically rebuilt on much more generous lines. It will be operated in connection with a Gayley dry air blast installation recently completed, and will give the Brooke furnace interests a total annual capacity of about 125,000 tons. Basic open-hearth iron is principally manufactured, with a mixture of anthracite coal and coke as fuel, and of late large quantities of Spanish and other foreign ores have been employed, as the proximity of Birdsboro to tidewater admits of low delivery charges. The furnace properties are managed by Robert E. Brooke, a son of Edward Brooke.

The Birdsboro Nail Works, established in 1848, have always constituted one of the most important branches of the Brooke manufacturing activities. Originally the rolling mill was operated by water power, but as the plant was extended this was supplemented by steam. In 1885, to operate on hot metal from the No. 2 blast furnace, two small Bessemer converters were installed, yielding an annual capacity of 18,000 tons of ingots. Other important improvements made from time to time have increased the semi-finished capacity of the works to 16,500 tons of skelp and muck bar per year, while the cut nail machines can turn out as much as 250,000 kegs annually.

The Brooke foundry operations, carried on under the name of the Birdsboro Steel Foundry & Machine Co., are the outgrowth of what was known as the Diamond Drill & Machine Co., a small concern manufacturing diamond drills at Pottsville. About 1885 this plant was removed to Birdsboro and located in the old buildings of the Birdsboro Iron Foundry Co., which had been idle since their purchase by E. & G. Brooke some fifteen years before. At first only an iron foundry and machine shop business was conducted, but in 1901-3 the steel foundry was added, two acid open-hearth furnaces being installed, one 20-gross ton and the other 25, and shortly thereafter the present name was adopted. This plant has an annual capacity of 12,500 tons in its iron foundry and 25,000 tons in the steel department; it is equipped for handling the largest classes of castings and has specialized on bridge, marine and locomotive work, special machinery and rolling mill equipment. George Brooke is president of this company, the other officers being: Robert E. Brooke, vice president; D. Owen Brooke, secretary and treasurer; and Leon E. Thomas, manager.

The ore requirements of the furnaces at Birdsboro come principally from the French Creek, Warwick and Jones mines, located some ten or fifteen miles south and reached by the Wilmington & Northern railroad. These properties were acquired many years ago, and George Brooke is a director of the connecting railway. From 1864 to 1887 the firm was interested, as sole owners, in the William Penn colliery near Shenandoah, Pa. This property, still one of the important producers in that coal district, was sold to Pennsylvania railroad interests over twenty years ago. The system of water supply employed by the borough was installed by the E. & G. Brooke Iron Co., and later was incorporated into the Birdsboro Water Co. On the lands of the iron company two miles south of the town large reservoirs have been constructed, assuring an ample supply of pure water and yielding a pressure sufficient for thorough fire protection.

As the Brooke manufacturing industries have long constituted practically the only source of support for the community, the problem of housing their employes has been one of importance and about 250 houses are now owned by the company. In the Hay Creek valley, near its junction with the Schuylkill, is a little group of houses rejoicing in the settlement name of "Texas," commemorating the fact that the Texan war was current at the time of their building. Similarly, another community nearby is termed "Mexico," for the reason that it was constructed during the Mexican war days. A natural interest in the welfare of the borough early led the brothers into an active participation in its public affairs. Edward Brooke was elected the first burgess of Birdsboro. George Brooke was for many years president of the town council, a member of the borough school board and a director of the library maintained by the St. Michael's Episcopal Church. Almost from its establishment he has been a vestryman of this church, which had its beginning as a mission. A large auditorium, known as Brooke Hall, is located in the property erected about 1876 to accommodate the store which the firm had opened originally in the old mansion house at the time they acquired the business. On every hand there are evidences, in the numerous advantages enjoyed by the borough, of the generous public spirit which has actuated the Brookes to give freely of both their energies and means for the material improvement of the community. Of George Brooke some one has said that his many years "have been filled with varying experiences, but withal have been flavored with a due measure of sunshine, the brightest ray of which to him must be the reverence and affection of his townspeople, which is almost filial."

Mr. Brooke is not now an officer of the E. & G. Brooke Iron Co. A son, Edward, is president, and his other son, George Jr., is secretary; with Robert E. Brooke, treasurer. He continues, however, as president of the foundry company, and his outside interests are numerous. He is president of two financial institutions at Reading, the First National Bank and the Pennsylvania Trust Co., in the organization of both of which he had an important part. He was also one of the founders of the First National Bank of Birdsboro, of which he was president until succeeded by his son, Edward; while George Brooke Jr. now gives largely of his time to the banking interests at Reading. Mr. Brooke has membership in the Union League and Manufacturers' Clubs at Philadelphia, having a city residence and sometimes spending a few winter months there; also in the Society of Colonial Wars and in the Sons of the American Revolution.

Near the crest of a hill overlooking Birdsboro and the Schuylkill Valley for several miles the George Brooke home is located. For many years early in the century the family occupied the old mansion house built in 1751 by William Bird, a substantial colonial residence, the lawn of which stretched down to the Schuylkill river, with a grove nearby which at one time served as a deer park. The building of the Schuylkill canal, however, robbed this location of its charm and a special residence was erected near the lower forge, but eventually this yielded to the growing demands of the works and it was torn down, about thirty years ago, to make room for the extension of the rolling mill. The result was the building of the present home, a magnificent stone structure, the porches of which command an exceptional view of the borough and its cluster of industries below and beyond of wide stretches of the picturesque country for which Berks county is noted. At one side is an abrupt descent to Hay Creek valley; across it one sees the wooded hills beyond which were located the two furnaces, long since dismantled. Leading up to the house are wide driveways, winding among great forest trees, the whole forming, in fact, a park-like expanse of surpassing beauty, about

which are scattered the homes of others of the Brooke family. From this viewpoint George Brooke can look down upon the scene of over seventy years' labor, with a group of thriving manufacturers and a prosperous, contented community to attest the success of his life work. But in another sense his outlook is vastly broader, for it can bring before him the quick succession of changes marking the progress of a great industry, onward from the days when the crude charcoal furnace represented the limit of advance in iron-making and the best of finishing equipment was the water-driven forge.

# CINCINNATI MARKET DURING THE PAST YEAR

## Ups and Downs of Southern and Ironton Irons—Ample Supply of Spot Iron at All Times—Scarcity of Low Grades—Year Ends With Easy Conditions for Buyers

By Joseph D. Morten.

The range of prices on southern iron during 1909 was from $11.00 Birmingham to $15.00, and on northern iron in the Ironton district from $14.00 at furnace to $17.50.

In the years 1908 and 1909, the January market was $13.00 Birmingham for southern iron, and in both these years the price declined to $11.00 in May. In both years, the buying began at that figure and in June the price advanced to $12.00, Birmingham. The action of the market two years in succession in the first half of the year is somewhat suggestive from two points of view, the first being that it may be reasonable to assume that $11.00 Birmingham might be regarded as a minimum price under adverse conditions for southern iron and a figure which buyers would regard as a safe investment basis. The second suggestive thought is as to the action of the market under the present circumstances, there being a liberal tonnage in sight, buyers' yards well filled and consumers largely covered for the first quarter of 1910.

The following tables show in what months the buying for 1909 delivery was done and the prices at which most of the purchases were delivered on contracts in each quarter of the year:

| Buying for. | Orders placed during. | Southern Birmingham. | Northern Ironton. |
|---|---|---|---|
| First quarter, 1909 | Sept., Oct., Nov., 1908 | $12.50 to $13.00 | $15.00 to $15.50 |
| Second quarter, 1909 | April, 1909 | 11.00 to 11.50 | 14.00 |
| Third quarter, 1909 | April, May, 1909 | 11.00 to 11.50 | 14.00 to 14.50 |
| Fourth quarter, 1909 | April to Aug., 1909 | 11.00 to 12.50 | 14.00 to 14.50 |
| First quarter, 1910 | Aug. and Sept., 1909 | 13.50 to 15.00 | 15.50 to 17.00 |

| Deliveries on contracts during— | Southern Birmingham. | Northern Ironton. |
|---|---|---|
| First quarter of 1909 | $12.50 to $13.00 | $15.00 to $15.50 |
| Second quarter of 1909 | 11.00 to 11.50 | 14.00 |
| Third quarter of 1909 | 11.00 to 11.50 | 14.00 to 14.50 |
| Fourth quarter of 1909 | 11.00 to 12.50 | 14.00 to 15.00 |

A feature of the year 1909 was the ample supply of prompt shipment iron throughout the year. At the time of the September advance, the conditions were compared in the trade with the boom period of 1907. The present situation suggests in the comparison that the 1907 prices were due largely to inadequate transportation facilities for the movement of pig iron and coke. There has been no scarcity of prompt iron at any time during the year 1909 and transportation has been prompt at all times.

The past two years have shown a notable scarcity of low grade irons, which is accounted for by the tendency of furnace men to sell the low grades on an analysis basis instead of by fracture and the constant demand for low grades by cast-iron pipe makers. There has also been more careful operation of the furnaces and a smaller production of low grades.

The course of the market in 1909 was steadily downward from January to April and gradually upward from May to October and the year closes with prices declining.

The year 1909 began with the market quiet and southern iron quoted at $13.00 Birmingham. Consumers were receiving iron on contracts costing from $12.50 to $13.00 Birmingham, the contracts having been made in September, October and November of 1908. Consumption was light, and there was but little interest in forward commitments.

In February there was a tendency to hold up shipments, the market became dull and weak with prices 50 cents per ton lower. During the latter part of February, the open market on steel products was declared and the situation became more unsettled and easier.

In March the southern market declined to $11.50 Birmingham with northern iron in the Ironton district down to $14.00, with buyers having enough iron coming to them to carry them through the first half of the year. Trade sentiment was to the effect that prices would have to reach an investment basis to encourage buying.

In April, $11.00 Birmingham became established with buyers showing considerable interest and furnaces opened their books on the basis of $11.00 Birmingham for deliveries extending over the remainder of the year. Southern furnace stocks were estimated to be 110,000 tons of foundry iron and 35,000 tons of basic, exclusive of the stocks at Virginia furnaces. The buying was heavy all through this month, and there was a tendency on the part of the furnaces to advance prices on third and fourth quarter business.

In May, while spot iron remained at $11.00 Birmingham, last half prices advanced to $11.50 with some furnaces asking $12.00 for the fourth quarter. In the Ironton district, $14.00 at furnace was the ruling price for all deliveries. Toward the latter part of the month, the market ruled firmer on northern iron, with $14.50 established by the close of the month. The melt up to this time was rather light and consumers began to hold up shipments. Tariff legislation was under discussion and general business was disturbed pending a settlement of the questions involved.

In June, there was more inquiry from consumers, spot iron advanced to $11.50 Birmingham and there was improvement in the melt. A liberal tonnage was in sight for third quarter delivery, but the continued scattered buying and general improvement in conditions gave the furnaces confidence and prices were maintained.

### Good Demand in July.

The month of July began with a good demand from all sources. Melters were in the market for their last half of the year requirements; and brokers, dealers, commission houses and investors were placing orders, at from $11.50 to $12.00 Birmingham. This heavy demand resulted in rapid advance in prices, so that by the close of the month prompt shipment iron was quotable at $12.50 and fourth quarter at

$13.00 Birmingham. Northern iron remained at $14.50 at Ironton furnace, which made the northern product relatively cheaper to consumers in this territory than southern iron, but the northern furnaces advanced prices late in the month to $15.00 for fourth quarter. A speculative sentiment was strongly in evidence and consumers wanted to cover as far ahead as possible.

During August there was continued scattered buying, new furnaces were going into blast, speculative iron was coming out with the new furnaces and speculative holders making the best price on spot iron. Most Southern furnaces were refusing to open their books for the first quarter of 1910, although a little southern iron was sold at $13.50 for these deliveries. Northern iron advanced to $15.00 for 1909 delivery and $15.50 at furnace for first half of 1910. Consumption was increasing, shipments were good, and the furnaces were cautious about taking 1910 business, some southern stacks refusing to open their books.

**Furnaces Independent.**

The month of September began with furnaces having enough orders on their books to be independent and firm in their views, while consumers were getting cheap iron on contracts and were fairly well covered through the year. A large tonnage of northern iron was sold for first half delivery at $15.50 Ironton and furnaces advanced their prices to $16.50. Heavy tonnages were placed in the latter part of the month and the continued inquiry and demand stimulated southern producers to put spot prices up to $14.50 Birmingham and to demand $15.00 for deliveries over the remainder of the year. This rapid advance proved to establish the highest prices of the year. We quote from the Cincinnati market report in the issue of Sept. 30 of THE IRON TRADE REVIEW in order to show how quickly the trade seemed to recognize that prices were under a strain:

At the advanced prices, melters are less eager to purchase and show some hesitancy, but the situation has not yet been tested, as the higher quotations have been too recently made to furnish opportunity of judging how they will be received by the buyers. The sentiment here is growing that foundry iron is perhaps unduly influenced by the steel making iron market. It is being freely exploited that visible stocks of pig iron amount to about 1,000,000 tons, mostly foundry grades, and that a large number of consumers have covered for the remainder of the year and first quarter of 1910. In the trade, the question as to whether top prices have been reached on this advance is under discussion.

**Buying Decreases.**

In October, buying and inquiry subsided. Northern iron was advanced to $17.50 for first half delivery with spot northern continuing at $17.00 at furnace. There were heavy transactions in basic, but there was little doing in foundry iron. One of the large southern producers opened its order books for the entire first half of 1910 at $15.00 Birmingham, without attracting orders.

In November, it developed that buyers regarded the market as too high to justify investment in forward delivery. Speculative holders of cheap iron attempted to realize on their holdings. Considerable free tonnage of southern iron came on the market. Furnaces were demanding shipping instructions on contracts, and the market weakened. At this time an interview with the president of one of the large southern furnaces was published in which he was quoted as intimating that prices would likely recede to $14.00, Birmingham.

In December the market continued dull and southern iron declined to $14.00, Birmingham, for delivery in either the first half of next year or prompt shipment. Speculative iron was pressing on the market and with the holidays close at hand, consumers well covered and generally heavily supplied with iron on their yards, the market dragged, with prices weakening under sharp competition on the part of sellers to secure the little tonnage wanted.

The proportion of southern iron consumed in the south was estimated last year to have been 61 per cent of the southern production and so far as can be ascertained this figure practically represents the proportion of the southern production consumed in the south during 1909.

**Outlook for New Year.**

The year 1910 begins with consumption at what may be regarded as nearly a maximum of melter's ability to use pig iron in this territory, which was the condition of the melt during the boom period of 1907. There are, however, a smaller number of foundry iron furnaces, which supply this territory, in blast and making foundry iron than during 1907. The supply and demand situation will likely be tested in the first quarter of 1910, as, with reasonably prompt transportation, the ability or inability of the furnaces to satisfy melters' requirements will probably be defined.

The action of the market in the first quarter will naturally influence prices for the remainder of the year. If melters' requirements are easily filled without absorbing the furnace production and lower prices result, forward deliveries will probably be obtainable at lower prices than now prevail. If, however, the furnace output be fully absorbed, a higher scale of prices may be expected. In this connection, it should be borne in mind that the present rate of production is encouraged and has been developed by advancing prices, and should the market decline the high rate of production could not well be maintained. These suggestions imply that the first quarter of the year promises to be an interesting period for observers of the pig iron situation.

PRICES OF SOUTHERN IRON (SPOT) FOR 1909.

| Date, 1909— | Southern No. 2 foundry, Birmingham, | Gray Forge, Cincinnati. |
|---|---|---|
| January average | $13.00 | $14.75 |
| February average | 12.70 | 14.62 |
| March average | 11.75 | 13.50 |
| April average | 11.00 | 13.25 |
| May average | 11.00 | 13.31 |
| June average | 11.31 | 13.50 |
| July average | 12.30 | 13.95 |
| August average | 13.00 | 14.62 |
| September average | 14.00 | 15.25 |
| October average | 14.50 | 16.62 |
| November average | 14.50 | 16.75 |
| December average | 14.00 | 16.75 |

## REBUILDING RAPIDLY.

The Jewett Car Co., Newark, O., car builder, advises respecting its recent fire that while it lost its wood machine shop and one lumber shed, press reports of the fire were greatly exaggerated. Both buildings were fully covered by insurance. Work of replacing the machine shop has been started, and the company has practically closed for all of its wood working machines, which will be motor driven. Work at the plant was not interfered with in any way, temporary machines having been installed, and it is now getting out its work with almost the same capacity as before the fire. When the new construction has been completed, it being hurried along as rapidly as possible, the company's capacity will be more than doubled.

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The Allen Engineering Co., organized with a capital of $40,000 by a number of Memphis, Tenn., investors, including Thomas H. Allen, N. Hill Martin, J. A. Omberg Jr., H. L. Alexander and G. D. Raine Jr., has secured a site at Leewood station, near Memphis, for the plant. The company will engage in general engineering and steel construction as well as foundry work. The construction of the proposed works will be begun the first of the year with the expectation of its being in shape to operate within three months.

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The Ohio Malleable Iron Co., Columbus, O., now a part of the Jeffrey Mfg. Co., of that city, is constructing a building 160x400 feet, of steel and corrugated iron. The foundation has been put in and construction will proceed rapidly.

# IMPROVEMENT COMES SLOWLY ON THE PACIFIC COAST

**Low Tariff Drives American Pig Iron From the Market—Important Improvement in Manufacture of Coke—Interesting Contest of Iron and Steel Bars—Prosperity Established and Outlook for New Year Encouraging.**

By H. Cole Estep

Prices of iron and steel products in Seattle in December, 1909, compared with the prices prevailing in January show the following net changes: English spot pig iron is $2.00 lower; English pig iron to arrive in three months is unchanged; English pig iron to arrive in six months is 50 cents higher; southern No. 2, domestic, is $1.70 lower; coke prices are practically unchanged; common iron bars are 5 cents per 100 pounds lower and soft steel bars are 5 cents higher; old material is $1.50 per net ton higher.

In view of the well known, marked improvement in general business conditions, these prices seem very peculiar, since in a number of instances actual declines are recorded and in others the advances are only very moderate. Nothing could better illustrate the influenec of the isolated position of the Pacific coast on local prices, and the effect of purely artificial and temporary circumstances on the market quotations.

For instance, in the case of English spot pig iron, the high prices in January were due to abnormally low stocks in the hands of the local jobbers and foundrymen, produced by the failure of several ships loaded with iron to arrive until long after their scheduled time. The effects of this stringency were not worn off until May, when spot quotations for imported iron began to crumble. The reduction of the duty on pig iron caused further scaling down in price until the low point for the year was reached in September. Improved business conditions have since operated to raise the price and the present quotations reflect with fair accuracy actual values, uninfluenced by artificial circumstances.

Imported iron sold to arrive at future dates reflected in a general way the conditions ruling the spot quotations. The midyear low prices were the result of the tariff reductions and the hesitancy on the part of buyers, caused by the slowness of the Pacific coast in responding to improved business conditions. The increases recorded in the past three months were effected by the long delayed business revival, coupled with rising prices in the English market.

Domestic pig iron from Alabama enjoyed a short season of prosperity on the north Pacific coast during the late spring and early summer. The causes operating in this instance were partly artificial and partly sentimental. Early in April, a reduction of $3.20 per ton in the freight rate on pig iron from Birmingham, Ala., to Pacific coast terminals was announced to be pending. The new rate, which finally went into effect May 25, amounted to $10.40 per ton and placed American iron for a short time on a par with the imported European product. At about the same time, the buyers in the northwest were experiencing a wave of sentiment against foreign irons produced by real or fancied improper treatment at the hands of the brokers and by a general feeling that the foreign materials were held at too high a price. Considerable buying of southern iron, therefore, set in and continued until late in the summer. The tariff reduction on imported stock and rising prices in the Birmingham market soon operated to effectually check any further buying of domestic iron. The year closes with American pig iron practically shut out of the north Pacific coast market.

### Improvement in Coke.

Local Wilkeson foundry coke has maintained an absolute uniformity in price throughout the year and foreign coke has fluctuated only slightly in response to vagaries of the sailing ship charter market.

The most important development of the year in the local coke market was the building of a new washing plant of 600 tons daily capacity by the Wilkeson Coal & Coke Co. This plant is now practically ready for operation and its construction marks a long step forward toward the production of a better grade of foundry coke on the Pacific coast. The existence of these improved facilities will enable the operating company to put a coke on the market running less than 12 per cent ash in contrast to the present product, which averages 16 per cent ash. This effort to supply a better grade of fuel is only one of a number of instances pointing to a growing respect for *quality* among the iron and steel interests of the Pacific coast, a characteristic which has been noticeably lacking in days gone by.

### Iron vs. Steel Bars.

In the merchant iron market, the year 1909 marks the conclusion of a long and bitter fight to establish soft steel bars permanently on the Pacific coast and at a definite increase over the price charged for common iron. This fight has been waged by San Francisco interests. Soft steel is now not only firmly established in the local market, but a 20-cent differential in its favor is strictly maintained over

MONTHLY PRICES, SEATTLE DELIVERY, 1909.

(In each case *minimum* prices are given. Pig iron is quoted in gross tons, coke and old material in net tons, and bars in hundred-weights.)

| Material. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pig Iron: | | | | | | | | | | | | |
| English No. 1 spot | $26.00 | $26.00 | $26.00 | $26.00 | $25.00 | $24.00 | $24.00 | $24.00 | $23.00 | $23.50 | $24.00 | $24.00 |
| English No. 1 to arrive—3 months | 24.00 | 24.00 | 24.00 | 22.00 | 22.00 | 23.00 | 23.00 | 23.50 | 22.50 | 23.50 | 24.00 | 24.00 |
| English No. 1 to arrive—6 months | 24.00 | 23.00 | 23.00 | 22.00 | 22.00 | 22.00 | 21.50 | 21.50 | 21.50 | 22.00 | 24.50 | 24.50 |
| Southern No. 2, domestic | 26.70 | 26.70 | 26.50 | 23.00 | 22.00 | 22.00 | 22.00 | 23.00 | 23.60 | 24.00 | 25.00 | 25.00 |
| Coke: | | | | | | | | | | | | |
| Wilkeson foundry coke | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 | 7.20 |
| European coke, future delivery | 10.00 | 11.00 | 11.00 | 12.00 | 12.00 | 12.00 | 12.50 | 12.50 | 12.50 | 11.50 | 11.50 | 10.50 |
| Bars: | | | | | | | | | | | | |
| Common iron bars | 2 25 | 2.20 | 2.20 | 2.25 | 2.20 | 2.20 | 2.10 | 2.05 | 2.00 | 2.00 | 2.10 | 2.20 |
| Soft steel bars | 2.35 | 2.35 | 2.35 | 2.35 | 2.35 | 2.35 | 2.20 | 2.20 | 2.20 | 2.25 | 2.30 | 2.40 |
| Old Material: | | | | | | | | | | | | |
| No. 1 foundry scrap | 17.00 | 17.00 | 17.00 | 17.50 | 17.50 | 17.50 | 17.50 | 19.00 | 19.00 | 19.00 | 19.00 | 18.50 |

common iron. The present price of $2.20 for iron and $2.40 for steel is general throughout the Pacific coast.

Importations of bars were steady throughout the first nine months of the year and increased heavily during the last quarter. Some shipments were landed at exceptionally low prices, as little as $1.70 being quoted ex ship Seattle. The new year opens with prices firmly maintained and prospects for larger importations of foreign material during 1910 than ever before.

In the foregoing, but little has been said about the demand for the various products or the volume of business transacted in the different lines. This is because influences entirely divorced from the laws of supply and demand were operating on the prices of Pacific coast iron and steel products during the year, and it seemed expedient to explain these causes clearly without reference to general market conditions.

### Slow Improvement in Trade.

The very evident general expectation of greatly increased activity during 1909, which was noticeable at the commencement of the new year, was not fully realized on the Pacific coast. Taking the year as a whole, the business done in the iron and steel trade did not exceed by more than 15 per cent that of 1908. It is significant also that the renewed activity has been almost entirely concentrated in the last quarter. The first nine months of the year were very quiet. The return of prosperity in the far west was very tardy. This was partly due to the fact that the west was slow to feel the depression and naturally slow also to respond to the revival. Furthermore conditions were not ripe for an early resumption on the Pacific coast.

It is a characteristic of business on the coast that it is practically all conducted on insufficient capital and in some instances on very meagre capital. This is a result of the very newness of the country and also of its surprisingly rapid development. This development requires large amounts of capital and prevents the west from creating any large surplus of its own. The effects of this hand to mouth condition are visible throughout the entire business fabric. A very cautious and hesitant resumption after a serious depression is only a natural consequence.

The demand for the various iron and steel products during the first half was only moderate. The expectation of a better demand, however, helped to sustain prices until well into May. Buyers still held off, and the declaration of an open market in the east late in February caused considerable uneasiness during the second quarter.

As a consequence, the summer months were marked by dullness, conservatism and general low prices. The foundry melt fell off and the demand for structural products decreased. The sheet and tin plate business alone exhibited activity.

Gradually in the fall, as conditions in the east became rapidly better and the Pacific coast finally accumulated sufficient capital to resume activity on a large scale, the market began to assume signs of life. In October consumers at last became thoroughly aroused and buying began in earnest. Spot pig iron advanced $1.00 a ton; iron bars advanced from $2.10 to $2.20 per 100 pounds and steel bars from $2.20 to $2.40. The trade in sheets grew apace and prices jumped, finally reaching a halt on Nov. 22 when 3.30c was quoted for No. 12 blue annealed and 4.00c for No. 12 galvanized.

The switchmen's strike on the northwestern railroads and disastrous floods in western Washington caused a considerable lessening in the business transacted in December, so that in the final summary October and November will appear as the most active months of the year on the Pacific coast.

### Important Announcements.

Two announcements, far reaching in importance to the iron trade of the far west, were made public during the year, one coming in January and the other in November. The first announcement was that of the successful organization of the Irondale Steel Co., which carried with it the inauguration of the first serious attempt to manufacture iron and steel products on the Pacific coast. Later in the year, the Irondale Steel Co. was reorganized under the title of the Western Steel Corporation and the capitalization was increased to $40,000,000. Work on the construction of the new plant at Irondale, near Port Townsend, Wash., has proceeded steadily during the year, although progress has not been as rapid as was expected. It is hoped, however, to blow in the blast furnace about the first of the new year and to roll the first steel ever produced on the Pacific coast sometime in March.

In November, came the announcement of the perfection of an agreement among the structural steel fabricators of the entire Pacific coast to use as much foreign material hereafter as physically possible. This decision was reached in an effort to force the transcontinental railroads to revise their freight rates on structural materials. If it is effective for any length of time, it will have a profound impression on the structural steel business of the Pacific coast and will enormously increase the importation of foreign materials. The local fabricators control about 65 per cent of the tonnage erected on the Pacific coast, which indicates the degree to which this agreement, if effective, will affect the Pacific coast market for structural materials and steel bars.

The new year is promising. The evil effects of the late depression have been finally cleared away. The latter months of 1909 made an excellent record. The December lull is generally considered to be temporary. The iron and steel business of the Pacific coast seems destined to enjoy its full measure of prosperity during 1910.

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## CORLISS COMPANY WILL BUILD STEEL AUTOMOBILES.

The Corliss Motor Co., of Corliss, Racine county, Wis., incorporated recently with a capitalization of $1.000,000, has purchased ten acres of land adjoining the holdings of the Wisconsin Engine Co., also of Corliss, and work will begin in 30 days on several modern factory buildings. The company will build a six-cylinder automobile, entirely of steel, but weighing 1,000 pounds less than any car of similar power, and will be listed at $3,000.

It is understood that the owners of the Wisconsin Engine Co. are backing the new concern. It was reported some time ago that a syndicate composed of these men had purchased the Owen-Thomas Motor Car Co., of Janesville, Wis., which leads to the belief that the Corliss Motor Co. is virtually a successor to the Janesville concern and will build the six-cylinder automobile designed by Owen Thomas and corresponding in all particulars thus far announced with the Corliss product.

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The Progressive Foundry Mfg. Co., of Racine, Wis., has been chartered. The capital stock is $10,000, and the incorporators include W. J. Kosterman and Edward Geb. The company succeeds to the business of Geb & Kosterman, foundrymen, at Racine.

# ALL IS NOT LOVELY IN THE BRITISH EMPIRE

**Gloom Gives Way to Improved Prospects, But There Are Still Some Unsatisfactory Conditions—Wage Reductions Cause Some Friction—Politics Interferes With Business.**

By J. Horton.

The year 1909, which commenced gloomily in Great Britain, closes with much better prospects and greater activity, but with a great many conditions which leave a good deal to be desired. The last month of the year finds a great many mills partially employed, with finished iron notoriously unprofitable, and a keen competition for orders. The official returns of prices and wages show remarkable steadiness. Under the Midland Iron and Steel Wages Board, the returns for January and February showed an average net selling price of £6 5s 4d.88 as compared with £6 6s 5d.63 for the previous two months. For March and April the average was £6 5s 0d.52, May and June £6 3s 10d.33, July and August £6 2s 9d.53, and September and October £6 3s 9d.52. The last two months of the year will not be reported upon until the end of January, but over the period in question, it will be seen that the variation since January is only 1/7d. A significant feature is that the last return shows by far the heaviest total output by the 17 selected firms, being 37,322 tons, the highest previous return being 33,874 tons in May and June, while some have been much below this. It will be remembered that during the 12 months ended October of last year, the reduction in price was about £1 4s, a rather striking contrast. Puddlers' wages have remained at 8s 6d per ton in the Midland district since December of last year.

In the northern district, there has been slightly more fluctuation but, on the whole, great steadiness in price. A reduction took place as the result of the September and October return last year, when the average selling price was £6 12s 3d.68. The ascertained average for September and October was £6 6s 11d.55, a reduction on the two months of only 3d.39 per ton. This leaves puddlers' wages at 8s 6d, or 3d less than at the commencement of the year, the only reduction since the beginning of 1909 being 5 per cent.

### Disparity Causes Friction.

One effect of the reductions in the north has been to correct a disparity between the north of England and the Midlands, which whenever it exists causes a great amount of friction. During 1908, this was a constant bone of contention, because it was asserted that the sliding scale gave the Midland iron workers too little wages, in comparison with the north, and to correct this, the premium under the Midland board was raised from 2s to 2s 3d per ton. The new premium seems to be working well, and giving general satisfaction. In spite of depression, Midland puddlers' wages have been maintained at 8s 6d as compared with a fall of 1s during the previous year. With reference to these boards, it may be remarked that they have quite maintained their pacific record, having had no trade dispute worth mentioning. The Midland organization, as employers and workmen frequently tell each other has preserved the peace of the district for the past 34 years. The scope of the board has been somewhat widened by the inclusion of the important district of North Staffordshire, following the example of South Wales about a couple of years ago.

Among the minor achievements of the year by the joint boards has been the establishment of the Sir David Dale Memorial Fund Lectures, and the utilization of the fund for the endowment of a chair at the Armstrong College, to be known as "The Sir David Dale Chair of Economics."

It may be recalled that, while there have been made complaints about the bad state of trade, business still compares favorably with that of 20 years ago when in the north of England wages stood at 6s 3d per ton, and bars were down to £4 11s 2d per ton. For the extra two pounds a ton over the earlier period, the workmen get 2s 9d a ton more in wages.

### Pig Iron Conditions.

The state of pig iron trade has followed with tolerable fidelity that of the finished departments, and shows that the trade declined during the earlier months, but recovered during the autumn. In January, Cleveland No. 3 pig iron was 48s 6d ($11.98). In May it was reduced to 48s ($11.76) with some slight fluctuations. Some recovery in the summer brought the figures of July to 49s 3d ($12.60), and in September to 51s 9d ($12.56). Since that time, there has been a little reaction, and, at the time of writing, Dec. 11, the market is slowly recovering, with the prospect that the end of the year may see a selling figure of something like 52s ($12.72). The latest return shows the number of furnaces in blast for the whole of the Kingdom as 297, an increase of 12 on the year. From the point of view of stocks the year has seen the heaviest increase for a long period. The stocks have grown from 120,000 tons this time last year to 370,000 tons at the present time, and are still rapidly increasing. The latest return shows 22,100 employed at the furnaces, an increase of 0.7 per cent compared with a year ago. This is not so good an increase as in the finished departments, where the men employed show an improvement of 6.3 per cent. It is significant that while all departments of the steel trade show improvement in employment, there is a falling off in the puddling forges, which may be taken as further evidence of the decline of puddling as a means of securing finishing materials.

### Not Entirely Optimistic.

In regard to pig iron, the feeling about the New Year is not altogether optimistic, as exports are comparatively poor for a period of improving trade, and there is much disappointment over the almost entire absence of American business. When the American boom commenced, everybody expected a big influx of orders for Middlesbrough pig iron. The more sanguine are still looking out for them, but it is admitted that, with certain branches of the American trade showing weakness, the prospects of British business are not very bright. Undoubtedly, there has been a good deal of speculative buying of pig iron based on the hope of American business, which has not been forthcoming. The hematite department which, for a long time, was much worse off than that of ordinary pig iron, has now much more cheerful prospects than its

rival department, owing to the great improvement in the steel-making industry.

All the finished trades have suffered a good deal from political and other influences and particularly from bank rate fluctuations. During the latter part of the year, these have been of a somewhat violent character. From May of last year, the bank rate continued at 2½ per cent, then, on Jan. 14, was raised to 3 per cent, and on April 1 came down to 2½ per cent. At this it continued for just six months rising to 3 per cent on Oct. 7, to 4 per cent on the 14, and 5 per cent on Oct. 21, at which rate it remained until Dec. 9, when it was reduced to 4½ per cent. The effect of the increase has undoubtedly been to discourage enterprise in large undertakings, and it has also affected the Cleveland warrant market by increasing the difficulty of financial speculation.

### Political Unrest.

Political unrest has also restricted business and the imminence of the general election at the close of the year, has practically stagnated enterprise. Business has been to an extent favored by the remarkable prevalence of internationl peace but at home there have been great outcries in regard to the inability of capital to bear the additional burdens lately imposed upon it by the government. This feeling, in fact, had much to do with the action of the House of Lords which has precipitated dissolution.

The close of the year finds the steel trade, on the whole, busier than for a long time past. This is partly due to the shipbuilding program of the government, itself inspired by the clamor for "Dreadnoughts" which coincided with the introduction of the budget in the spring. But warship building is comparatively only a drop in a bucket and there are still complaints of unemployed plant and capital at the great shipbuilding centers. At the same time, there is a considerable revival and some of the largest builders of warships are busy on ships or material for Spain, South America, Russia, and in connection with colonial naval enterprise. It is agreed that the shipbuilding revival generally has only just commenced and there are doubts as to its ultimate extent. In March last, the Tyne was so full of laid up steamers that it was found necessary to find dock room at Norway and Hamburg. Business has not yet been found for many of these idle vessels. On the other hand, the rapidly increasing requirements of ocean service are shortening the working life of all classes of vessels, and forcing replacements. While the yards are all busier, an enormously increased demand could very easily be met. Both from Sheffield and Middlesbrough, there are reports of a considerable amount of unemployment, the needs of which have to be met by various forms of philanthropy.

### Railways Not Buyers.

The very limited character of trade recovery is mainly due to the meager demands upon structural engineers. The railways in particular are persistently pessimistic and so far have ordered scarcely anything in the way of rolling stock and railroad materials. When they seriously come into the market, the effect must be very considerable. They are just now putting in an appearance by inviting stores tenders, but in other branches they make no sign. Apparently, the builders of rolling stock are hopeful, as the principal establishment in Birmingham has just placed a contract for material for extension of plant involving 3,000 tons of metal, an order which, by the way, has gone to Dorman, Long & Co., of Middlesbrough. Structural engineers report that material is not quite as readily obtainable as it was a month or two ago.

In regard to steelworks equipment, the great firms have shown considerable enterprise in modernizing their plants. Among the most recent achievements is the rolling of plates at a large Newburn establishment, 30 feet by 7 feet 6 inches by 3 inches thick, from nickel steel. Another plate was 34 feet by 11 feet by 3 inches thick. Each of these plates weighs over 14 tons, and is believed to be for the equipment of one of the "Dreadnought" ironclads being built at Jarrow. The north engineering houses all report some increase of activity, and there is a better demand for boilers, forging presses, hydraulic machinery, and similar plant.

In the Midland district, the engineering shops are busier, and in particular establishments producing dynamos, turbines and other electrical machinery are doing better. Probably a larger number of rolling mills both for iron and steel have been equipped for electrical driving during the present year than in any previous period, and a large amount of capital is ear-marked for further extension in the same direction.

A noteworthy effect of the period of depression, which it is hoped is now complete, is the comparatively insignificant influence of foreign imports of iron and steel. A considerable amount of billets are always coming, particularly by way of Newport, but this year they have been smaller than usual, foreign makers having apparently wearied of a class of business which has so often enabled British manufacturers to defeat in open competition continental structural engineers. The gradual revival on the continent has during the past six or eight weeks, further restricted these supplies, and will probably progress further in the same direction in the new year.

### Association Influence.

With regard to the influence of association, steel makers have successfully maintained their arrangements for the regulation of prices, by which manufacturers are restricted to the supply of certain districts and any advantage arising from geographical situation or the absence of railway rates is counteracted. In this department, the most interesting event was the collapse of the Galvanized Sheet Association in the summer. The year commenced with galvanized sheets selling at £12 10s f. o. b. Liverpool, and this in spite of the fact that, black sheets had fallen enormously in value. The effect of the collapse was to bring down prices at one swoop to £10 .10s. They have since recovered up to £11, and makers are now hoping that the storm has been safely weathered. The collapse after several years successful working was due to outside competition from seceding or openly hostile makers facilitated by a price admittedly inflated. It is notorious that while the association lasted, or at all events until within a few months of its collapse it was an immensely profitable enterprise for the associated firms, while it also enhanced the profits even of outside makers. The recovery of prices sufficiently testifies to the vitality of the trade, and even without the association the close of the year finds this branch of the iron trade with as bright an outlook as that of any department. Makers are looking forward to an excellent year in 1910.

The tinplate trade, which was dull at the beginning of the year, has had an excellent run for the last six months. Tin plates were selling in January at 11s 10½d per box, and they are now 12s 10½d, with a most encouraging demand, and all the works fully employed, while additional mills are being put down. It is remarkable that this is to an increasing extent an export industry, it being estimated that only 23 per cent of the tinplate product is consumed by Great Britain. Local tinplate makers claim that their capacity for high class production is equal to any in the world. It may be remembered that at the beginning of the

year statements were made professing to be authoritative announcing a tin plate combine between this country and America, but the rumor was very promptly denied.

Probably on the whole steel manufacturers have done much better than iron masters throughout the year. This is partly due to the entirely better equipment for steel production enabling makers to produce on a large scale and make profits at prices which are impossible in the old fashioned iron mills. But another reason is the increasing consumption of billets and bars as raw material. While a certain demand still exists for puddled iron, the puddling furnaces are gradually disappearing, and large numbers of works buy the whole of their raw material in the semi-crude steel state. The price of billets closes the year practically at the same figure as in January, though there have been slight fluctuations. Finished steel prices have been very steady.

### The Eight Hours' Act.

The expectations in regard to dear fuel as resulting from the eight hours' act have not been realized. Coal seems to be as cheap and plentiful as before, and while coal masters have suffered through additional outlay, for the most part the change has been one of rearrangement of workings, and the consumer has not been called upon. This has been rather fortunate for the ironmasters, whose burdens, with dear raw material, heavy taxes, and more trying legislation, have been almost intolerable. With regard to next year, the prospects are considered hopeful, and it is believed that while a great many iron masters would welcome a victory for the Tariff Reform party, and are working strenuously to that end, it is quite possible that the trade recovery indicated in so many directions will continue even at an accelerated pace in the event of the election not turning out in accordance with their own wishes.

# LOCATION AS AFFECTING IRON AND STEEL INDUSTRIES

## Why Many Blast Furnaces and Steel Works Have Failed—Transportation Problem—Importance of Labor of the Right Kind—Market Advantages—Changing Conditions Which Will Affect Making Selections of the Plants of Future

By John Birkinbine.

About a score of years ago, a wave of financial excitement traversed the eastern section of the country, resulting in the sinking of millions of money in prospective towns and cities, located from Maryland to Texas, whose initial inducement was the erection of blast furnaces and steel works. Some few of these enterprises may be classed as successes, others gave existing communities a temporary impetus—but the great number were failures. Lines of improved streets with sidewalks, water pipes and sewers are now traversed by the residents who represent remnants of communities, and who lingered after the industries which had been partly or wholly completed were razed or moved elsewhere. Vacant tenements, or large hotels with few if any guests are monuments of unverified expectations, and in some localities graded streets now sustain growing crops; but all point to the fact that iron and steel industries are not *at home* in every community.

In a number of instances the boom towns had some basis for the hopes of investors, as iron ores, fuel and flux, were convenient or transportation was available, but these are not the sole requisites for a successful iron industry. Other prospective towns, where lots were sold at prices ruling in large established cities, had little if anything on which to prognosticate an industrial future. This town boom craze has passed and is now but a memory, except to the thousands scattered throughout the country who still feel the burden of making good money lost in the bubble. Our rapidly increasing population and development suggest that it may be instructive to consider the essential elements in determining how location affects the iron and steel industry.

### Location as Affecting Iron and Steel Industries.

The predominating factors, which at present influence the establishment of industries devoted to the production of iron and steel, differ radically from those controlling the selection of sites for the earlier blast furnaces, in the United States, rolling mills, etc., although accessible sources of raw materials, iron ores, fuel and flux, are as important to the new as to the older plants, from whose success the great iron and steel industry has developed. But the advance in transportation facilities, both by land and water, with improvements in mechanical appliances for handling large quantities of material from cars to vessel, or from vessel to dock or cars, has done much to eliminate the necessity of juxtaposition of raw materials to the blast furnaces or to connected plants or mills.

### Progress in Metallurgy.

An important factor in the advancement of the iron and steel industry is the progress made in metallurgy. While this may not be generally accepted as influencing the location of industries, the work of the chemist has made possible economies in the use of raw materials, and the production of augmented outputs of metal, which affect the capacities of plants and the minerals with which they are supplied. The development of various portions of the country and the distribution of industries have also had decided influence upon locations as affecting iron and steel manufacture.

The fact that improvements in appliances for handling materials in great quantities, and economies in transporting these by water or on land, have each encouraged the assemblage of minerals from distant points, does not detract from the value of having raw materials in juxtaposition as in the Birmingham district of Alabama, except in so far as this advantage is affected by other factors. Thus the character of Alabama ores, as compared with many domestic ores used elsewhere, would limit their immediate application if it were not that satisfactory coking coal and flux are also close at hand.

### Early Iron Works.

In the United States, until about 1840, charcoal was the fuel used in blast furnaces or in forges into which iron was fed, and a necessity in selecting a

site for such an industry was ample forests from which a supply of wood was obtainable for producing charcoal. The then abundance of wooded areas in the older settled states of the nation gave considerable latitude in choosing locations, and brought into prominence the ore supply, which also had to be of desirable quality, sufficient in quantity, and convenient to the furnace or forge, although the annual amount of ore used in one of the older plants was no greater than that supplied daily to some individual furnaces now active.

Power being developed by water required that locations be made upon streams, the drainage areas and profiles of which presented opportunities for hydraulic power development. The older blast furnaces and forges were therefore mainly erected by streams draining hilly areas covered with forests, and convenient to acceptable ore supplies, and the moderate quantity of flux required kept limestone from being a controlling feature.

As most of the sites chosen were necessarily distant from markets for the work's product, this was accepted as an unavoidable handicap, for then, as at present, the consumer paid the freight, but these iron works were, wherever possible, connected by roads with turnpikes, highways, canals or rivers leading to market centers.

With industries located on mountain streams in forested areas it was essential to house the labor required, and to keep the workingmen actively employed, for an idle plant meant starving employes. As a consequence, tenements were provided contemporaneously with the plant and its appurtenances, and labor was utilized in various ways according to change of season. The winter weather, which interfered with open mining, and often with transportation, was utilized in cutting wood for the charcoal supply of the next season, for relining the furnace and for general repair, and a miner or collier was for a part of the year a wood-chopper.

The "Captains of Industry" responsible for existing enormous iron and steel plants may doff the hat to the energy, ability and foresight of the men who as pioneers established iron works in the depths of the forests, built roads to make the sites accessible, created communities of workers in the wilds, constructed mills, cleared and cultivated farm lands, erected furnaces for which all material was either quarried or cut from the estate or hauled long distances.

### Old Iron Masters Mighty.

As illustrating then existing conditions, the following is quoted from a paper presented by the writer before the Engineers' Club of Philadelphia, in 1902*. "The control of the iron works was generally under the personal direction of the owner or of the party with the largest financial interest, who exercised absolute dominion over a considerable territory. The employes of each plant produced its fuel from wood cut and carbonized upon property connected with the furnace or adjacent thereto, mined ore from its own or convenient lands and quarried limestone near by, thus making these early iron works self dependent. The works also maintained its store, smithery, and generally a mill to supply the employes and their families, little money was used, most of the labor being taken out 'in trade'.

"The aggregations of houses about these iron works which sheltered the employes and their families as tenants of the owners, were settlements independent of others, often reached by long and tedious wagon journeys.

"The transportation of the materials to the furnace or forge, and also of the product from them was by animal power, first on the backs of mules, and later by wagons, each drawn by a number of animals which made extended journeys to points of consumption, and brought back, with the necessary supplies required for the community, news from the outside world. The owner, or 'iron master' was practically 'monarch of all he surveyed', owning the lands, farm, furnaces, forges, mill, store, tenements, not infrequently the church and schoolhouse, or at least the ground they occupied, and while slavery prevailed in a portion of the United States, some iron masters were also owners of employes. If he elected to serve, the master was justice of the peace and postmaster; otherwise trusty subordinates were named at his dictation. He was the political, and in some instances, the religious guide for his people; but often did not intrude as much upon religious duties as upon political privileges, giving to his employes and their families unlimited proxies to represent him at the revival services at which a number got religion each year, at least a supply believed sufficient until the frogs croaked in the spring, after which it was often accepted as more or less of an incumbrance.

"Long credits allowed on the sale of products, or claimed on the purchase of materials, made the owner or manager of these elder plants a banker, whose fiscal work was mainly confined to short seasons recurring once or twice every year."

A few plants used "arks" on rivers to convey their products, but as the country developed, canals and railroads improved transportation facilities, the use of mineral fuel encouraged the location of iron works either upon these traffic avenues or within easy reach of them. Progress in manufacturing machinery of increasing power encouraged larger plants, and furnaces and mills, while keeping convenient to ore and fuel supplies, were located close to market and labor facilities, and to communities from which labor could be drawn.

Most of the iron-producing plants consisted of a single blast furnace, and many of these were operated to supply a forge or mill, but as these subsidiary industries increased in capacity, twin plants, or those having more than two furnaces were erected, and to a considerable extent the industry concentrated about producing centers; a condition which now prevails.

### Present Distribution.

The distribution of the blast furnaces of the United States is graphically presented in a map issued by the United States Geological Survey,* an examination of which indicates how small a portion of the area of the country these important industries cover, and demonstrates that most of the blast furnaces are tributary to a few centers, a condition encouraged by availability of supplies of raw materials, by market for product and by the labor obtainable. The term accessibility does not in this sense mean juxtaposition, for the great bulk of the mineral fed to the blast furnaces of the United States covers long distances. There are exceptions, such as the Alabama-Georgia-Virginia-Tennessee district, where the transportation of most of the materials is confined within limited areas, but in no portion of the country is there such a liberal development of the iron and steel industry as in the region between Pittsburg, Pa., and Cleveland, O., which is dependent upon Lake Superior ores meeting the coke of Western Pennsylvania, some of the latter, however, being conveyed 100 miles or more. The section convenient to Chicago has shorter ore hauls but much longer coke hauls. The Buffalo-New York district has moderate transportation for coke, long haul for ore. The Eastern Pennsylvania and New

*Changes in the Manufacture of Pig Iron—Proceedings of Engineers' Club of Philadelphia, Vol. XIX, pp. 223-240.

*U. S. Geological Survey Report on Iron Ores, 1908.

Jersey region, while using some local ores, supplements these by foreign ores and by those brought from the lakes or from Northern New York, and depends upon anthracite coal with a short haul and coke with a long haul.

The iron and steel manufacture in the Rocky Mountain section and beyond, is developed on a small scale, except in Colorado, where a plant of six blast furnaces draws the bulk of the ore used from 400 to 650 miles, and the coke for about 100 miles, but having a good market for products, and having developed a satisfactory labor element, this plant is an important factor in the industry of the country. There are also scattered locations of a few furnaces each of which will come under one of the classes named, and a number of charcoal furnaces whose location is dependent upon a supply of this fuel. These, however, contribute but a small modicum of the pig iron production. Seventy per cent of the pig iron producing capacity of the country comes from blast furnaces none of which are distant from any of the others more than 600 miles, and a circle with a radius of 125 miles includes plants which are contributing more than one-half of the pig iron made in the United States.

While distance has in a number of cases been practically nullified, freight rates charged are not always contingent upon distance and quantity, a condition brought prominently before the public in a late interview with the president of an eastern steel company, having had extended experience in the Pittsburg district prior to his association with the eastern enterprise, who claimed that Pittsburg had been largely favored by the railroad interests.

### Survival of the Fittest.

A number of successful iron and steel plants are developments of earlier and less pretentious industries, but the majority of the older works have passed into history. Some of those active have especially favorable local conditions as to the supplies of raw material, but most of the survivals have continued because the management has kept abreast of the times and sufficient capital has been available to maintain these modern works. The decadence of the industry in some localities which appear favorable may be traced to inadequate capital or non-progressive management, and the continued prosperity of some relatively small plants may be credited to the policy of advancing with the industry elsewhere.

The extension of the iron and steel industry has in late years been most pronounced along the great lakes and in nearby territory, a development undoubtedly influenced in part by the Lake Superior iron ore region supplying about 80 per cent of the output of the domestic mineral. Facilities for cheaply and rapidly handling iron ore from vessels, the use of metal cars of large capacity, the unloading of these by car-dumpers, and the transfer of the ore dropped from them by traveling bridges and capacious buckets, unite in reducing the cost of moving ores to furnaces at rates which permit of utilizing these at considerable distances from the lower lake ports.

As fuel must be carried to the industries adjacent to the lakes, the transportation of this assists in offsetting the freight on ore to inland plants.

These newer enterprises are also situated to command a market, and have the advantage of competing rail as well as water transportation, while communities from which a supply of labor is obtainable are in most instances convenient.

### Blast Furnace Locations.

In a paper contributed to the American Institute of Mining Engineers in 1892* the writer included a table of "The Distribution of Population and Production of Pig Iron, according to Census Returns of 1860, 1870, 1880 and 1890," and it appears pertinent to summarize this table with the record for 1900 added.

In four decades, 1860 to 1900, the population of the New England States, while advancing in number, represented 10 per cent of the total for the country in 1860 and 7½ per cent in 1900, while the pig iron output had not advanced and now may be practically eliminated from the country's greatly augmented production.

As charcoal is the fuel employed to smelt local ores producing special iron, the prospect of larger product may be considered as dependent on plants which may be erected on the sea-board in the future, fed mainly with foreign ores and probably with foreign fuel.

The Middle States were credited with 24 per cent of the population of the country in 1860; although the number of inhabitants had more than doubled, the proportion of the nation's total fell to 20 per cent in 40 years, and while in this interval the pig-iron output was augmented over ten times, the proportion of the country's total declined from 71.5 per cent to 50.3 per cent.

With the exception of parts of the ore supply brought into the United States from Canada and of that received at Baltimore, all of the foreign ores are imported into and used in the Middle States, and it would seem probable that along the Atlantic sea-board especially desirable locations may be found for prospective iron and steel industries.

There are also in this section, and in some others, deposits of magnetite whose contents of metallic iron, of sulphur or of phosphorus, suggest the practicability of beneficiation. The magnitude and extent of these and of others in which titanium is present indicate that in the near future they may become important factors in meeting the demands of blast furnaces.

The abundance of ores requiring no pre-smelting treatment has heretofore limited the application of those apparently less desirable minerals.

The population of the southern states was nearly doubled in the 40 years, but the proportion fell from 31.7 per cent in 1860 to 25.2 per cent in 1900, and the pig iron production, although increased 26 fold, has shown but moderate proportionate growth.

The record of the western states accounts for many changes in the older settled sections during the four decades. Its population increased 3½ times and the pig iron production 30 times, the former advancing from 34.2 per cent to 46.9 per cent of the nation's total, and the latter from 15.6 per cent to 31.7 per cent. But in the western states is included a large producing territory which has its business relations closely affiliated with the middle states, where state boundaries are obliterated in favor of district divisions, and the data are now only presented in their present form so that comparison can be made with the older records. In the United States, the population increased 2½ times and the pig iron output 15 times.

On the eve of another census it may be unwise to attempt comparisons in detail, but from present indication the census year 1910 will show a population approximately 90,000,000, and a pig iron output of 27,000,000 tons, and a resume of 50 years will demonstrate that the country demands in 1910 nearly ten times as much pig iron per capita as in 1860.

A summary of the table referred to, in addition to such data as are fairly estimable for 1909, appears below to supplement this resume.

The figures are for census years, except for 1909, which are estimated from data available. And to those for the four general divisions named for Con-

*Vide "The Influence of Location Upon the Pig Iron Industry," Transactions A. I. M. E., Vol. XXI., pp. 473-491.

tinental United States, the record of Pennsylvania is added, as this state has been and is the largest individual producer of pig iron.

**Comparisons of Population and Pig Iron Production by Decades in Various Sections of the United States.**

| Years. | Population. | Pig iron production. Long tons. | Inhabitants per ton of pig iron made. |
|---|---|---|---|
| NEW ENGLAND STATES. | | | |
| 1860..... | 3,135,283 | 26,600 | 117.87 |
| 1870..... | 3,487,924 | 30 778 | 113.33 |
| 1880..... | 4,010,529 | 27,640 | 145.10 |
| 1890..... | 4,700,745 | 30,162 | 155.85 |
| 1900..... | 5,592,017 | 13,487 | 414.62 |
| 1909..... | 6,260,000 | 19,000 | 329.47 |
| MIDDLE STATES. | | | |
| 1860..... | 7,571,201 | 706 369 | 10.72 |
| 1870..... | 8,935.821 | 1,171,115 | 7.63 |
| 1880..... | 10,643,486 | 2,143,833 | 4.96 |
| 1890..... | 12,869,293 | 4,657,670 | 2 76 |
| 1900..... | 15.639,413 | 7 263,098 | 2.15 |
| 1909..... | 18,500,000 | 13,300,000 | 1.39 |
| SOUTHERN STATES. | | | |
| 1860..... | 9,981,480 | 100,761 | 89.06 |
| 1870..... | 10,859,955 | 164,768 | 65.91 |
| 1880..... | 13,975.686 | 311,639 | 44.95 |
| 1890..... | 16,236 784 | 1,582,106 | 10.26 |
| 1900..... | 19,188,127 | 2,594,721 | 7.40 |
| 1909..... | 21,875,000 | 3,400,000 | 6.43 |
| WESTERN STATES. | | | |
| 1860..... | 10,755,357 | 153,829 | 69 92 |
| 1870..... | 15,274,671 | 466,215 | 32.76 |
| 1880..... | 21,526 032 | 892,799 | 24.11 |
| 1890..... | 28,815,428 | 2,283,436 | 12.62 |
| 1900..... | 35,729,729 | 4,580,928 | 7.80 |
| 1909..... | 41,630,000 | 8,900,000 | 4.68 |
| TOTAL FOR UNITED STATES. | | | |
| 1860..... | 31,443,321 | 987,559 | 31.84 |
| 1870..... | 38 558,371 | 1,832,876 | 21.04 |
| 1880..... | 50,155,783 | 3,375,911 | 14.86 |
| 1890..... | 62,622,250 | 8,553,374 | 7.32 |
| 1900..... | 76,149,386 | 14,452,234 | 5.27 |
| 1909..... | 88,265,000 | 25,700,000 | 3.44 |
| PENNSYLVANIA. | | | |
| 1860..... | 2 906,215 | 580,049 | 5.01 |
| 1870..... | 3,521,951 | 922,564 | 3 82 |
| 1880..... | 4,282,891 | 1,723,492 | 2.48 |
| 1890..... | 5,258,014 | 4,207,599 | 1.25 |
| 1900..... | 6,302,115 | 6,778,584 | 0.93 |
| 1909..... | 7,345,000 | 11,250,000 | 0 65 |

1909 Estimated.

### Labor Conditions.

A factor apparently often neglected in considering the location of an iron and steel industry, is the labor problem, and it is probable that more disasters have come to large plants from this than any other cause. As a rule, the successful steel plants of the present are developments from modest beginnings, or are the neighboring off-shoots from adjacent works, and in the list of those who have maintained an uncertain existence against odds for years, plants which were established on a large scale are prominent.

It is not necessary to particularize, but the list of iron and steel plants which were established at new locations supplied with blast furnaces, converting and fabricating works, which, although well equipped, have had to struggle for existence, can be verified by those familiar with the industrial development of the country, and the men upon whom their management rested can tell to what extent the labor problem influenced results.

These statements do not particularly refer to organized labor as it is now recognized in associations dominated by one man, or a coterie under such rules as limit the activities of members, but cover the broad field of labor organized or unorganized.

It has been the experience of some plants erected at points distant from districts where iron and steel manufacture predominate, that a number of years have been necessary to develop a satisfactory force of employes. A works located away from others may be started on a supply of labor in number greater than is really necessary, but a large proportion of this may be classed as peripatetic, whose tenure of any position is limited either by a desire to change, or as likely by wish of the manager that a change be made. Consequently the question of labor is a serious one for an iron and steel industry located in a new district, and although comfortable homes are provided in communities supplied with public utilities, and other inducements are offered, the best and most desirable men are difficult to entice from present environments.

It is not many years since a particular class of uneducated labor dominated every iron and steel works. At blast furnaces the iron-breakers who separated the hot pig from the runners and carried the metal from the casting houses have given way, in many works, to the hot metal cars and casting machines. These men, who though generally ignorant, were skilled in this arduous labor, were the continual cause of anxiety to furnace managers. The chute bins, charging cars, and skips, have also largely displaced the top and bottom fillers, and the traveling bridges have taken the place of many ore stockers.

But the blast furnaces are still dependent upon labor skilled in handling the devices which have so greatly reduced the number of men employed, and the marvellous equipment of steel works and rolling mills demands men familiar with the mechanism and acquainted with the details in fabricating products.

A new industry must therefore depend upon labor imported from elsewhere, or for a series of years pass through an educational process which segregates the desirable from the undesirable element. Some of the most successful works of the country are operated where there would appear little inducement at the present time to establish these, but supplementing any advantage of securing the necessary materials or of satisfactory transportation they are surrounded by a community from which labor can be drawn and in which there are few able bodied men unfamiliar with some of the special duties the proper performance of which make an iron and steel works successful. A man having a comfortable home with friendly affiliations, with church or lodge connections, with children passing through a course of study in schools, and whose wife has neighborly ties which bind her to the locality, is slow in deciding to abandon a community with which he is familiar for one of which he has little, if any, knowledge. At some of these works bonds of friendship, if not affection, exist between the employes and those who direct them and this fact deters some from changing an old for a new boss.

### Market Facilities.

That market facilities form a controlling factor in determining the location of industries is demonstrated by the growth in the vicinity of Chicago, which has become prominent in the production of iron and steel, although it is distant from supplies of ore and blast furnace fuel, but convenient to other fuels and to fluxes, while a greater number of railroads radiate from there than from any other American city, which with the lake transportation makes Chicago an unexcelled distributing point.

Pittsburg, which is the center of the greatest pig iron production, (about 20 per cent of the nation's total being credited to Allegheny county, Pa.) is also well supplied with competing railroads, but the number of railroads does not in all cases influence the location, for St. Louis, a noted railroad center on the great Mississippi river, sustains a relatively less important iron industry than formerly.

There is a smaller iron-producing equipment at the sea-board cities than was formerly the case, with the exception of Baltimore, near which a large steel plant is operative, although these cities have unlimited water transportation and from most of them competing railroads reach other portions of the country. Under normal business conditions Lake Superior iron ores compete with ores from foreign countries close to the sea-board, and the distances which must be covered by satisfactory metallurgical fuel are no greater, from mine to sea-board than from mines to some of the large and successful plants now in operation, and it would seem that the transportation

charges on domestic ores to be mixed with foreign ores, or lean ores convenient to the sea-board, which could be successfully beneficiated, would be offset by the market facilities which these cities present.

A decade ago, one of the great transportation companies whose lines of railroad were connected to develop coal fields from which an ample supply of satisfactory metallurgical fuel was obtainable, and with deposits of iron ore whose extent and character were inviting, submitted to the writer the question of establishing a large iron and steel plant. The apparent abundance of raw materials of desirable composition was supplemented by controlled mileage of track sufficient to require a large output of rails, in fact, the distances covered were such as to preclude supplying all of its lines from the proposed plant. Hence, the factors of material of desirable character, transportation facilities existing or readily obtainable, a market for part of the product and ample capital at command, suggested unusual inducements for the establishment of an industry. A careful study of the project was continued for several months and all phases of the situation discussed, including possible foreign as well as domestic trade, with the result that a large iron and steel plant was not then advised, but it was suggested that a less pretentious enterprise be considered, which would encourage the exploitation of deposits of mineral, develop a local trade which could later be extended, and educate a laboring force as a nucleus for future enlargement. In other words, there appeared good reason for erecting a plant of modest proportions, but the project of constructing a complete iron and steel works seemed to be premature, and it is not unlikely that in the future an important industry may be developed.

The conclusion arrived at was not affected by the combinations which have so changed conditions, but primarily because the market would not warrant the erection of a plant which could compete with others by manufacturing rails or shapes of standard weight and because the necessary labor would have to be imported or educated.

A mill which cannot make all the standard sizes, or which can only be operated intermittently is seldom a paying investment, and the smelting and converting departments of a plant need to be in keeping with the producing capacity for finished product.

This does not mean that small plants may not be remunerative and successful if designed and equipped to furnish material of a special grade, but that generally a complete industry, which requires the exploitation of mines and which provides for all processes from receiving the raw material to finished forms now employed, is advantageous because of its capacity in quantity of output, and if large product goes out of the mills, liberal amounts of billets must enter them, and ingots or molten iron must be supplied to meet these requirements.

### Combinations.

The enormous capital at command, the modern equipment installed and the concentration of large industrial works established under one management, which permit of utilizing specialists, have a most important bearing upon the present and may be expected to influence any future extension of the iron and steel industry. That these facilities may act as deterents to individual effort in establishing minor enterprises is admitted, but such admission does not mean that individuals or corporations controlling iron and steel works of moderate capacity may not obtain from existing plants, or from those which may be erected, satisfactory returns for the capital invested.

The era of combination which is now considered as existing, has developed a sentiment favoring some governmental control, and neither the interest of the country nor of the combinations will be served by a practical monopoly.

The control of supplies of ores and metallurgical fuel is a necessity for plants whose product represents enormous quantities, and the advantage of having a practically permanent reserve of raw materials is also of value to industries of minor size. But the fact that the holdings of great corporations represent reserves figured in hundreds of millions of tons is not to be interpreted as indicating, as some assert, practical control of our natural resources. The "new finds" among ore and fuel fields which have long been exploited, supplemented by the development of territory heretofore unproductive; the reopening of deposits which although formerly wrought have lain inactive, the beneficiating of ores or fuel to remove objectionable characteristics, the application of concentration, or nodulization to iron ores, of washing and by-product coking to coals, and the possibility of obtaining values from waste, each assists in broadening the field from which supplies are obtainable.

The above applies to minerals now developed or explored, but in our country, with its extensive area, its variety of topographical and geological features, there are known to be stores of resources awaiting exploitation as commercial advancement brings them in demand.

### Changing Conditions.

In the future as in the past, fluctuations are to be expected in the quantities of iron and steel produced, but the output of these essentials must keep pace with national progress, and we may confidently anticipate continued advances in iron and steel metallurgy which will affect the present and create other productive centers.

The changes in equipment, such as substituting gas engines for steam motors, applying rotary instead of reciprocating mechanisms, and the rapid extension of by-product coking to coals which under ordinary conditions do not give satisfactory results, each are worthy of consideration in connection with the future sites of iron and steel manufacture.

This presentation is not presumed to cover all conditions affecting iron and steel manufacture, but is offered as summing up some important elements which affect location. The apparently excessive capitalization; the heavy interest charges upon large bond issues; the domination of financial rather than practical control in many works are worthy of discussion.

But whether new industries are established by individual partnerships, corporations or combinations, their success will largely depend upon foresight in selecting locations, and in such selections proper weight must be given to each of the factors which have been above enumerated.

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The Mumford Molding Machine Co., which has been organized to sell the foundry molding machines heretofore sold by the E. H. Mumford Co., of Philadelphia, will have its sales offices at 30 Church street, New York City. W. D. Sargent is president; E. H. Mumford, vice president and general manager of the new company. These molding machines will be manufactured for the new company by the Quincy, Manchester, Sargent Co., at Plainfield, N. J.

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The General Electric Co. has changed the date of its fiscal year, which, hereafter, will end Dec. 31, instead of Jan. 31, as has been the case since the incorporation of the company. The report for 1909 will, therefore, cover only 11 months' operation.

# GREAT ACHIEVEMENTS ON THE IRON RANGES

## SLOW BEGINNING FOLLOWED BY WONDERFUL ACTIVITY

### Strike and Accidents Fail to Prevent Making of New Record of Ore Shipments—Some of the Latest Mining Developments—Popularity of Companies Based on Square Dealing.

By W. I. Bartholomew.

The close of the mining season of 1909 brought home to the attention of all observers of the Mesabi range and its operation the fact that the development and organization of that wonderful strip of territory are now about as efficient as engineering and business skill can make them. The season of 1908 had been one of depression in which laborers in large numbers had left the range and work had gone on at a leisurely pace. Spring came and found the business world hopeful but still in doubt as to the extent of the revival that was believed to be impending. It may be that here and there a business prophet foresaw the magnitude of the tasks the coming season was to impose, but it is certain from admissions of some of the largest operators on the range that mining men in general had no adequate notion of what was to come, and as a matter of fact were taken decidedly by surprise when the demand for ore took on record-breaking proportions. It was in the early spring that a correspondent of this journal wrote: "It is expected that the coming year will be one of moderate activity, with about such improvement as was indicated by the improvement in business late last season." He probably reflected the general opinion at that time.

The first ore went south from the mines to Two Harbors April 20, and when the lake shipment figures appeared they showed the total shipments for the Minnesota ranges up to June 1 to be 2,550,260 tons. A comparison of this figure cannot be made with that for the corresponding period in 1908 for the reason that a general agreement curtailing shipments was in force then, but the figure for the same period in 1907 was 4,365,855. These figures bear nearly the same proportion to each other that the total shipments in 1908 bear to those of 1907, and a conclusion might have been drawn in accordance with the ideas of the early prophets that 1909 was not to show anything more than a moderate gain over 1908. The June shipments from Duluth, Superior and Two Harbors were 3,987,582 in 1909 against 5,777,139 in 1907. Of course, the shipments were better than the June shipments in 1908, which fell below the two million mark, but there was yet no hint of record breaking. It was not until the July shipments were complete that 1907 was left decisively behind, the figures comparing 4,908,855 for 1909 to 2,621,957 for 1907. Record breaking was on in earnest in August, when the Minnesota ranges shipped nearly 5,000,000 tons, and the total shipments from lake ports were 7,193,199, a new record for the lakes. Another 7,000,000-month was seen in September, and at the end of the year the total record of 41,683,875 tons was marked up against 41,288,755 for the previous record in 1907, of which the Minnesota ranges sent down 29,192,139 tons.

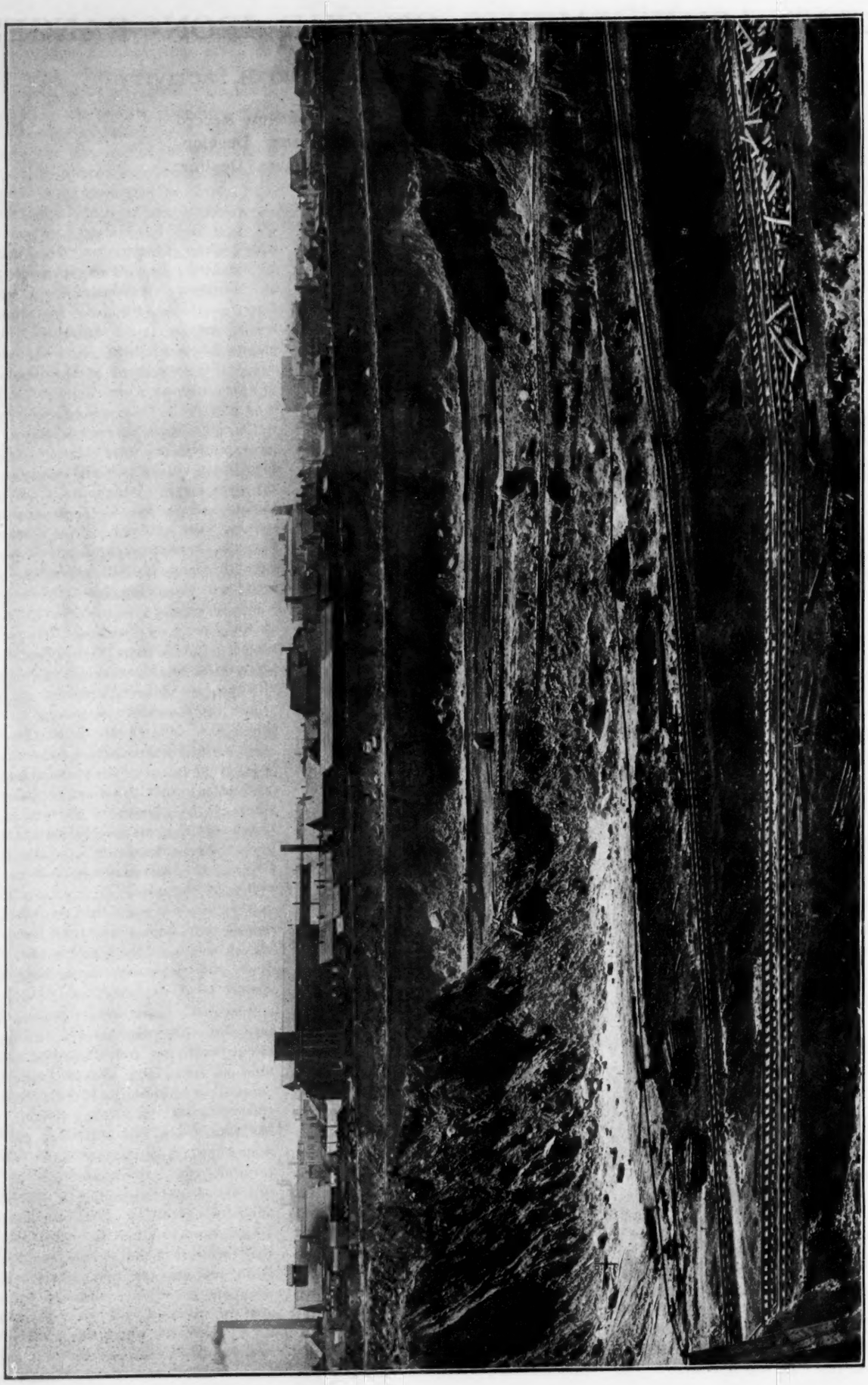
#### Difficulties Encountered.

Militating against the completion of this wonderful year's work was the strike of the marine engineers, which was declared May 1, an exceedingly stormy month in October, which greatly delayed shipping, an accident which wrecked the lower gate of the Canadian Soo lock in June, and the ramming of a gate in the Poe lock in November, which tied up a big fleet. The engineers' strike, while it doubtless seemed formidable at first, proved not so important as it looked, for it spent its force before the mid-season onrush of business began. However, it did delay shipments materially for a time and adds wonder to the phenomenal record that was made. Doubtless the response of the range to the unprecedented business revival is the most significant fact in the history of the season's work. Many elements contributed to make this response possible, but the most conspicuous was the development work that went on in the face of bad times during the dull season of 1908 and the winter of 1909. This policy maintained mining organization intact, added new properties from which ore could be taken, and bettered old properties by exposing more ore and improving the facilities for handling it.

Contributing largely to the season's success were the amicable relations that existed throughout the season between employer and employed so far as actual mining work was concerned, and if the intelligent and liberal cultivation of public good-will is a useful form of strike insurance, the iron men are building a strong bulwark between themselves and possible labor trouble in the future. Everywhere throughout iron ranges of Minnesota the citizens, whether directly interested in the iron industry or not, are a unit in their praise of the fairness of the big iron industries in their control of the destinies of the various communities in the iron country. This regard for public welfare is shown in various ways. It is exhibited by the United States Steel Corporation at Coleraine, one of the youngest communities on the Mesabi, where the Corporation's subsidiary, the Oliver Iron Mining Co., is retaining sufficient control over the lands in the village to prevent the enormous multiplication of saloons, which is the curse of most of the towns on the range. In other towns, club houses have been built for mining employes and in the united villages of Gilbert and Sparta the Oliver company is spending something like $40,000 on a waterworks system to give the village pure water.

At Hibbing, one of the best known citizens of the town was asked if none of the people of the place objected to the manner in which the mines were cutting off streets and so altering the surroundings and topography of the place as to make them unrecognizable even to the natives, unless they kept close track of mining progress. "No," he replied, "we don't object because the mining men always treat us fairly."

But there were other general features of the year besides the great mining activity and industrial peace. One of them was the statewide discussion of the tonnage tax, a discussion that is far from quieted yet. Minnesota has and still does tax the mines upon their value, which is determined by an examination of the properties and a study of the books and drill records. The tonnage tax, which came before the legislature in the form of a bill, was intended to add a specific tax upon every ton of ore mined, and the campaign for that sort of taxation met with no setback until April 20, when the late Governor Johnson returned the tonnage bill which had passed both houses, with



PART OF THE SELLERS MINE AND APPROACH. MANY OF THE BUILDINGS SHOWN ARE TO BE REMOVED TO MAKE ROOM FOR MINING.

his disapproval, and thereby prevented it from becoming law. Throughout the northern part of the state, including all the country dependent upon the ranges, the movement for the tax is deemed a sectional issue in which the argicultural and general commercial interests to the southward are bent upon extracting all they can get from the mining corporations without much regard to the principles of taxation, and Governor Johnson gave some weight to this view of the matter in his veto message. Doubtless Minnesota's admiration for her dead statesman and her confidence in his honesty and sound judgment will not be without its weight in future discussions of the subject, if it comes up again, and it seems likely that it will be an issue at some later date.

### Progress at Coleraine.

In actual mining operations, no district on the Mesabi presents more of fresh interest than the work of the Oliver Iron Mining Co., at the western end of the range around Coleraine, Marble and Taconite. One authority estimates the expenditure of the Oliver company there at $12,000,000, and the actual prduction of ore in the district has scarcely begun. The interest centers largely in the fact that the improvements there represent to a large extent an attempt on the part of the corporation to make the sandy ores of the district commercially useful. The existence of ore in the neighborhood has been known almost as long as the range itself has been known, but the heavy mixture of broken down taconite in much of the ore had always driven operators elsewhere until the Steel Corporation took hold of the work. The expense and labor involved in the enterprise were enormous, but success promised a commensurate reward, for the range extends westward for miles beyond Coleraine and across the Mississippi river, and a competent authority estimates that the experiments at Coleraine will result in the addition of from 12,000,000,000 to 15,000,000,000 tons of merchantable ore to the world's supply. That the Steel Corporation believes that it has succeeded in solving the problems involved in the successful handling of the ore is evidenced by the activity with which it is pushing to completion the concentrator now building on the shore of Trout lake to the southward from Coleraine. This structure when complete will be the largest ore washer ever built. As a preliminary to its construction, an experimental washer was built in 1907 and used during a part of last season, so that it shipped 42,000 tons of ore before it was dismantled. What remains of it is now merely a heap of wreckage and the coming of the next shipping season is expected to see the new washer in commission. This structure is to be built upon the unit plan and when fully completed it will consist of 15 units each with a capacity of 2,000 tons of crude ore for a day of 20 hours. The completed structure will require 8,000 tons of structural steel. For the coming season, five units are to be completed. To deliver the ore to the washer it has been necessary to provide for bringing the loaded cars to an elevation of 95 feet, at which the ore is dumped into the washer, and this elevation will be reached by a fill the proportions of which are in keeping with the gigantic apparatus it will serve. Its height at one point is about 110 feet above the level of the ground upon which it rests. To reach this elevation, three lines of trestle work were built, one above another, and filled in with spoil from the Walker and Canisteo pits. The fill, which contains about 2,500,000 yards, is believed to be the highest ever built in this country for the purpose of carrying a railroad track, and of course it would not have been attempted, had it not answered the purposes of a mine dump at the same time that it was providing a way to the top of the washer. After the ore is once delivered to the washer, all but about 8 per cent of it will be handled wholly by gravity and will drop into cars on the Duluth, Missabe & Northern tracks at the bottom a high grade ore. The tailings will be carried through a launder directly to Trout lake, while the power house and pumping station are located on the shore of the lake at a sufficient distance to insure a supply of clean water.

Just what features the new washer is to have that differ from those in the experimental washer, and the facts as to the details of construction in the new structure, are still business secrets known only to those directly connected with the enterprise.

### Some Ore Shipped.

But the district does not depend wholly upon washed ore for its usefulness. During the season, the Holman mine at Taconite shipped 400,000 tons and the Walker at Coleraine shipped 100,000 tons. Stripping, however, was still the great industry in the district. The Canisteo and Walker mines stripped 2,400,000 yards, the Holman 990,000 yards, and the Hill 2,000,000 yards. In the years from 1906 to 1909, inclusive, these mines moved 14,500,000 yards of material.

In this district near Taconite, the Oliver Iron Mining Co. is sinking a shaft on a new property to be known as the North Star. It is on land acquired in the celebrated Great Northern Ore Co. deal. It will be operated underground and its product will not be a wash ore.

Cutting a slice off the north end of Hibbing, is one of the enterprises in the Hibbing district in which the Steel Corporation is now engaged. Hibbing is the metropolis of the Minnesota ranges and, on account of the vast extent of the neighboring mines, is likely to continue so, but there is such wealth of iron under its foundations that, sooner or later, all, or the most of it, must move.

The necessity for the work now in progress arises from various mining considerations. To the north and west of Hibbing, the Sellers, Burt, Pool, Hull-Rust and Mahoning mines have cut off egress from the town except over one road threading its way between open pits, while the outlet for the Burt-Pool and Sellers bends around the end of the town to the southeast and crosses property belonging with the Susquehanna mine of the Buffalo & Susquehanna Co. But this company is preparing to strip the Susquehanna mine and another way out must be found. To accomplish this, the Sellers and Burt-Pool are to be given a new outlet which will carry their product westward. This involved cutting through from the Sellers and Burt properties to the Hull and incidentally severing the town's connection with the country to the northwest. This damage, however, will be repaired by building a bridge over the new excavation. But this is only the beginning of the changes. In the northern end of Hibbing, close to the scene of these operations, stand the Steel Corporation's offices, engine house, machine shop, laboratory and a large collection of structures used for mining and other purposes, and all of these are to be moved and the area stripped so as to make the mines involved, into a continuous open pit that will be in the neighborhood of two miles long.

The site for the new headquarters has been chosen west of the southerly end of the town. It consists

of 20 acres upon which work was begun last October, and since the Corporation has plans for extensive and costly buildings, it may be assumed that the location is one where shovels cease from stripping and town sites are at rest. The office will be three stories with a basement, and the machine shop 215 x 115 feet, which will give more than twice the floor space in the old shop. The equipment in the old buildings is to be used elsewhere and new machinery will be installed in the new plant.

Another important feature of this program is the contemplated construction of a new railroad outlet from Hibbing. The stripping of the Susquehanna will greatly constrict the present limited area over which tracks can be carried out of Hibbing. It was stated upon apparently good authority that the plan was to build a branch of the Duluth, Missabe & Northern south from Hibbing to meet the Alborn branch of the road and proceed thence to Duluth. This would involve building something like 20 miles of road, but would give a somewhat more direct route to the docks. It has not yet been definitely announced that this enterprise will be carried out.

FILL AND APPROACH TO THE STEEL CORPORATION'S WASHER AT COLERAINE IN PROCESS OF CONSTRUCTION.

### Two New Mines.

Aside from this extensive project the operations of the Steel Corporation in the neighborhood of Hibbing were mostly of the routine kind. West of the Mahoning mine, the Corporation is opening two new pits, to be known as the Uno and Dale. Neither is a large mine. The Uno may be a shipper the latter part of next season, but the Dale will not appear in the shipping list before 1911. Another new property will be the Mississippi, an underground property near Kewatin, which will be in the active list next year. It is to have an 8 x 20-foot timber shaft, with nothing out of the ordinary in its equipment or character.

Early last year, the Oliver Iron Mining Co. made an important change in the organization of the district. W. J. West, who was superintendent of the Hibbing district, also had the mines around Chisholm under his care. This district is now divided and he keeps the Winnifred, Morris, Sellers, Burt-Pool, Hull-Rust and the new mines, while M. H. Godfrey takes the Pillsbury, Glenn, Clark, Chisholm, Leonard, Monroe, Tener, Myers and Hartley, with headquarters at the Monroe location near Chisholm.

Other companies operating around Hibbing were kept exceedingly busy during the year, but new developments in the region were not numerous, though some marked changes are contemplated for the future. One of the projects is the stripping of the Webb mine belonging to the Shenango Furnace Co., which will still further encompass the beleaguered town and will form a link in a chain of pits which it is declared may some day reach all the way to Chisholm, more than four miles distant. The stripping of the Susquehanna, already mentioned, will be a tremendous task, for the overburden is about 150 feet deep and is heavier than anything yet attacked on the range. When this work is to be begun has never been announced, but it is a fact that the engineers have all the plans ready and are only waiting for the company to give the word. One fact which lends reasonableness to the project is that the Sellers, which adjoins the Susquehanna, has been stripped in some places to a depth of more than 120 feet.

The business of sinking concrete shafts, while rather an old story on the range, still attracts attention. Two of these are going down near Hibbing. One is at the Scranton, a mine adjoining the land on which the Steel Corporation is building new offices. This mine, in which the Lackawanna Steel Co. is interested, is to be operated by Pickands, Mather & Co., and the contract for the shaft was taken by the Foundation Co., of New York, which has a virtual monopoly on that sort of work on the range. The same company is at work at the Morton mine sinking a similar shaft

for the Tod-Stambaugh Co. The Scranton's nearest neighbor is the Penobscot, a Steel Corporation property which now does duty for a well, a fact which suggests why a concrete shaft is advisable in that locality. Work began there in the early fall and in less than two months 80 feet of the necessary 150 feet had been excavated. Most of the digging was through quicksand, in which the clam shell bucket could make rapid headway. The shaft differs in no essential respect from that at the Morton, which was recently described in detail in these columns, the only considerable departure from the ordinary being that while the shaft wall as viewed from the outside is cylindrical, the shaft is rectangular. Contrary to the general and uninstructed idea, these shafts do not sink gradually and imperceptibly as the excavation proceeds from within. Their progress is by sudden drops with prolonged periods intervening when they are stationary. While the question of what will happen when a shaft is sunk is always an open one, the rapid progress already made and the borings before work started lead to the belief that the Scranton shaft will find its way to bed rock without great difficulty, but it is not expected that the mine will be in the shipping list next year. The Scranton consists of 120 acres and the deposit of ore is said to be extensive.

### Trouble at the Morton.

The Morton shaft has encountered considerable trouble. It is to go down 190 feet and has been more than a year in sinking. In the fall, work came almost to a dead standstill because of the difficult nature of a stratum which was reached at about 130 feet. Blasting failed to loosen this material so that it could be handled by the clam-shell and a continuation of the story of this work, telling how the difficulty was overcome, will make an interesting addition to the history of engineering operations on the range. One rather striking feature of the operations at this shaft was the appearance during the season under the cutting edge of the shaft and inside of it of timbers that originally formed a cofferdam outside of the shaft when the sinking started. The gradual subsidence was the cause of this curious phenomenon.

Just as the year was ending the Foundation Co. closed another contract for one of their shafts on Oglebay, Norton & Co.'s Woodbridge property near Buhl. Work was begun there by the Oglebay-Norton people on a timber shaft during the year and was carried down for a distance sufficient to satisfy them that there was too much water to be handled by ordinary methods and the attempt was given up, and negotiations opened for a concrete shaft. It is to go down 95 feet and work is to be started as soon as the appliances and material can be assembled. The short distance the shaft will sink and the character of the ground lead the firm to believe that the shaft can be turned over to them next spring. The character of the shaft is similar to the Scranton shaft, a circular section outside and rectangular section inside. The shaft will be 10 by 17 feet. This mine lies next to the Whiteside mine of the Shenango Furnace Co., where a valiant battle against water was in progress during the season. It is a new mine with steel head frame and shaft, the first equipment of the kind on the range. At the end of the year, the company was 200 feet down and in ore, but at one time water was so abundant that work was stopped. Late in the season, new pumps and boilers were installed and pumping started again.

The Interstate Mining Co., the mining arm of the Jones & Laughlin Steel Co., has renewed the stripping of the Grant mine near Buhl. As early as last February, this project was put under way by letting a contract to Butler Bros. to do the work. About 5,000,000 yards will be stripped, 1,000,000 of which was to be stripped the first year. This project is interesting because it follows the attempt made to strip the mine with clam-shell buckets operated on cables stretched across the property. A persistent effort was made to demonstrate the usefulness of the plan, but the experiment appears to have had nothing more than a negative value. It showed that the method was not suitable for the work and Butler Bros. went back to the steam shovels and dump cars.

Exploratory work was active around Buhl. The Duluth Exploration Co. had something like 10 drills at work on sections 13, 14 and 9, and the Carlson Exploration Co. was also drilling near Buhl.

To the eastward of Buhl near Kinney, the Seville Mining Co. has added a producing mine, the Seville, to the range. This is one of the enterprises started by A. B. Coates of Virginia. It is an underground mine and is far enough advanced to have accumulated a stock pile ready for shipping. In the neighborhood and near the Jennings mine, Swallow & Hopkins are stripping a new property known as the Helmer. James S. Rayburn is the superintendent in charge of the work. The Holland mine, formerly operated by this firm at Biwabik, is worked out and dismantled. It began shipping in 1905 and in its three active years produced 270,864 tons.

### Virginia Was Busy.

Virginia, always a busy center, was not conspicuous in 1909 for new work, but the steady routine of digging out ore and sending it south kept the established mines busy. The Sliver, an M. A. Hanna & Co. property operated by the Virginia Ore Mining Co., a subsidiary, continued stripping as its principal activity, although ore was reached and mined in 1908. Stripping was also active on the Steel Corporation's Alpena, a mine which has never appeared in the shipping list except when hyphenated with the Sauntry, which was active in 1902 and has not been since. The Sliver and Alpena are adjoining properties and to make room for their operations the tracks of the Duluth, Rainy Lake & Winnipeg railrad had to be moved during the season. A spur from the Duluth, Missabe & Northern was run into the Sliver during the summer.

Corrigan, McKinney & Co's Commodore had a busy year, but fell somewhat short of its record. After the shipping season was done, a steam shovel was set to work excavating and grading for a new track to the mine shops. The variously named Oliver group operated by the Steel Corporation had a big season and will show well up in the list of the year's producers. Standard tracks of the Duluth, Missabe & Northern were built into the pit during the season.

In June the city gave A. B. Coates the right to drill in the northern part of the town. He controls the mineral rights to a property inside the city limits, and in due course it is expected that a new mine will be opened.

At Chisholm the shipping by the Steel Corporation was confined to its underground properties and about 1,800,000 tons were sent out. The Pillsbury and St. Clair were entirely idle, but stripping was carried on actively at some of the other properties. At the Monroe, where the water conditions at one time compelled the pumps to work at the rate of 5,000 gallons a minute, the pumping problem is slowly solving itself and the

flow last season was only about half what it had been.

In this district is located the Jordan, formerly operated by Corrigan, McKinney & Co., which is now worked out. A new enterprise in Chisholm is the mine on the shores of Longyear lake, which was proved up by J. P. Labrec and is now being operated by the Euclid Mining Co. It is known as the Euclid mine and is now a producer.

Early in February, the legal formalities for the annexation of Sparta to Gilbert were completed as a part of the work preparatory to moving Sparta off its townsite and converting its streets and lots into an open pit mine. It was one of the Oliver Mining Co.'s projects and the purpose ready mentioned, undertook the construction of a system of waterworks for the combined villages.

The Gilbert mine, at Gilbert, which appeared in the shipping list in 1907 with about 100,000 tons and advanced to over 300,000 in 1908, has been greatly developed and could have sent down a million tons last year had that much been asked. The Sparta mine at Sparta, a Pickands, Mather & Co. property, has been definitely declared a worked-out mine.

Eveleth, like its neighbor Virginia, was the scene of active mining, but not much that is striking in the way of new enterprise. The principal interest here centers around the new mine, the Virginia, which is being opened by Pickands, Mather & Co., old underground workings being used as dumps, a new shaft was added to those already in use, and though the property is one of the old and highly productive mines, a good deal of drilling was done. The Fayal, which closed the season of 1908 with a total production of 16,253,193, added enough more during the year just closed to run its total production to over 18,000,000 tons, and thereby passes the Mountain Iron in total product and heads the list. The Fayal, however, has never equaled the 2,563,111 tons of the Mountain Iron for a single year's production, and could not have taken the lead had not production from that property been cut to something over 200,000 tons in 1908 and shut down in 1909. Stripping in the

PART OF THE FAYAL PIT AT EVELETH. ITS OUTPUT DURING THE YEAR PLACED IT IN THE LEAD IN POINT OF TOTAL PRODUCTION.

was to extend the Genoa mine, which ceased operations after a strike in 1907. To carry out the plan, the Steel Corporation was compelled to buy out numerous land owners at prices which would remind a real estate dealer of boom times in Los Angeles. The houses were either moved or torn down, and their former owners flocked to Gilbert, a short distance away. The town numbered but a few hundred and by August tracks were laid up the principal streets of the village. Before the close of the year the street itself had largely disappeared and in its place an open cut had appeared with two steam shovels working in it. In addition to its work in moving the village, the Steel Corporation, as al-

west of the Adams mine. The fee is owned by Marshall Alworth, of Duluth, and the stripping contract was awarded to Winston Bros. & Dear, who began work last summer. A mining man familiar with the property described it as almost an ideal mine of the Mesabi range type. It lies on the side of a hill, where the drainage problem almost solves itself, has an overburden of only about 25 feet, and contains a large body of Bessemer ore. It will be among the shippers next season.

### Fayal Has Good Season.

The Adams mine was active both in shipping and development. A large amount of stripping was done on the property, the caves from the Fayal is continuing this winter and some decided changes in the aspect of the mine will be made before shipping begins again.

During the season, the operation of the Spruce required the caving of a considerable area just adjoining the main street of the town, and the property was vacated and fenced. The cave extends up almost to the back doors of some of the business places on the street, but it is stated that operations in that direction will extend no further.

Toward the eastern end of the range at Biwabik and beyond, there was considerable new work in progress. Joseph Sellwood began early in the year to get a new property south of the Stevens, called the Per-

kins, in shape to ship. McArthur Bros. began shipping and mining and before the season was done they had cut through the over-burden and taken out about 60,000 tons of ore. McArthur Bros. also went to work on a new property, the Hudson, for Pickands, Mather & Co., and a track was laid from their Mohawk mine to the Hudson. This property will ship the coming season. A new shaft was built at the Mohawk and at the Bangor ore was reached and considerable drifting was done. This was one of the earliest mines on the range to be supplied with a concrete shaft. Water is a bothersome feature of mining in this vicinity and the mine is already pumping about 3,000 gallons a minute with the prospect of an increase as the workings are enlarged.

The Hector and Ajax at Biwabik, formerly controlled by George A. St. Clair, of Duluth, which were quite generally supposed to be worked out, were turned over during the year by Mr. St. Clair to the Interstate Mining Co. and work has been resumed at both mines. The Spring mine, controlled by Mr. St. Clair, which had been allowed to fill with water, was unwatered after having been idle a year and operations were resumed in December. An 80-acre tract north of the Spring, which is not yet named, will be added to the list of Mesabi range mines during the year. It is to be stripped and operated as an open pit. In resuming operations at the Spring mine and opening the other property there, Mr. St. Clair is pushing operations close to what is believed to be the eastern limit of the workable area of the Mesabi. They lie five miles east of Mesabi Junction.

### New Sellwood Property.

A new mine to be added to the Sellwood properties is the Pearson at Nashwauk, another growing center on the Mesabi. It lies north of the La Rue and though wholly a product of last year's work, it shipped 60,000 tons. During the season, A. P. Silliman, of Hibbing, drilled extensively between the town and Swan Lake, four miles north. At the La Rue, which during the season became one of M. A. Hanna & Co.'s properties, Butler Bros. stripped a new approach and continued the conversion of the mine into an open pit. At Nashwauk and to the westward in the Coleraine district, considerable trouble was occasioned early in August by a tremendous fall of rain which flooded the open pits, stopping operations and causing considerable delay and damage. The mining and commercial interests of both of these towns will be benefited by the extension of the Great Northern from Nashwauk to Grand Rapids, which was completed about the close of the year.

## VERMILLION RANGE.

Actual mining operations on the Vermillion range were confined during the year to the properties of the Oliver Iron Mining Co. with the one notable exception of what was done on the famous Section Thirty property, now controlled and operated by George A. St. Clair of Duluth under an arrangement with the fee owners, the F. W. Eaton estate, Lon Merritt, R. H. Fagan, George Lonsdorf and L. C. Harris. The property, which lies eastward of Ely, about two miles, was located in 1883 and that same year a contest as to its ownership arose and lasted 20 years, finally ending in the supreme court of the United States. During that time, a fortune was spent in fighting for the property and another lost in futile development work before the property was proved to be a mine that would pay for working. Among the interests that tried and failed were the Clergue syndicate, the Shagawa Iron Co. and the Midland Steel Co. One shaft on the property was down 550 feet when Mr. St. Clair took hold about two years ago and another was down about 90 feet, while one of the numerous drill holes on the property is 1,300 feet deep. The shallower of the two shafts has been deepened to 150 feet and proper drifts and cross cuts made so as to develop a considerable ore body and a small stock pile has been accumulated. Many samples of the ore have been analyzed, showing that some of them ran as high as 67 per cent in metallic iron with the average well over 60 per cent while in physical character the ore corresponds with that from the Pioneer mine near Ely.

At present the mine is completely isolated from the rest of the world owing to the lack of railroad facilities, but it is stated that this difficulty will be remedied during the coming season and it is expected that the mine will appear in the shipping list before another year, thus breaking the monopoly of Vermillion ores which has been held by the Steel Corporation for years. There is, however, one reason for qualifying this statement. There has been a good deal of negotiation for the control of the property and, while Mr. St. Clair may operate the mine himself, it can also be stated that he may turn the work over to some other interest.

It has been a generation since the mines at Tower on the western end of the range and those at Ely on the eastern end were discovered and while the formation can be traced all the way from one town to the other, nobody has ever actually developed and operated any new and successful mines in the district, though millions of dollars have been spent in exploratory work on the Vermillion. The discovery of the Mesabi range and its possibilities for cheap mining put an end to activity on the Vermillion, but with the growing conviction that the Mesabi offers no further fields for the prospector and the success of Section Thirty, activity on the Vermillion has returned to fever heat. Opinions differ as to how these new enterprises will fare. Claims of new discoveries were made throughout the season and doubtless most of them are sincere while it is possible that some of them are founded on something more substantial than enthusiasm. It is not unreasonable to believe that there is more ore on the Vermillion than has been uncovered, but the attitude taken by careful mining men toward all these new enterprises has been that of the man who says "Show me."

This attitude is based upon the long record of failures and upon the known unreliability of drill records in operations on the Vermillion. One experience of the Oliver Iron Mining Co. along that line will indicate the reason for the skepticism. From a drift in one of the company's mines, a diamond drill was started downward at an angle of 45 degrees. This drill made its way for a distance of 1,625 feet and when tests were made it was found that the drill had gradually changed its course until at the extreme end of the hole it had turned upward and was on its way to the surface when drilling was discontinued.

### Many Operators.

A catalog of all the interests now engaged in drilling and test pitting on the range would be a long one and not particularly significant. On at least 11 locations on the range, drilling or other exploratory work was in progress during the year and probably the number is considerably greater. Some of these enterprises are in new locations and others on lands that have been tried out more or less in other years and abandoned,

while a large number of companies have been formed or are being promoted.

Prominent among those who are seeking new mines on the range are J. P. Labrec, who recently developed the Euclid mine at Chisholm and turned it over to the Euclid Mining Co. The moving spirit in the Vermillion Steel & Iron Co., which is doing a good deal of work, is Thomas J, Walsh, who has been advocating the claims of the Vermillion for the last quarter of a century. Another prominent interest is the Vermillion Iron Development Co., which has prospects in the neighborhood of Tower and the township next east, while the Roy Development Co. has sunk a shaft near Tower Junction.

In actual mining, the Vermillion did not enjoy the same degree of activity as that experienced on the Mesabi. The mines were not driven to their full capacity and in fact not much more than half the ore that could have been mined went to the docks. At the Pioneer, a new steel shaft house and ore trestle went up during the year, marking the disappearance of the last wooden shaft house on the range. At the close of the shipping season, the Pioneer had a stock pile which was roughly estimated to contain about 70,000 tons.

The one range remaining for mention is the Cuyuna, where all the work so far accomplished has been of an exploratory and preliminary character. The district is now served by the Great Northern Railroad, but it is expected that next season will see the Cuyuna Iron Range road complete to Crosby in anticipation of the beginning of actual operations. Rogers, Brown & Co. and George H. Crosby are the principal operators on the range, though exploratory work has been carried on by a number of other interests. Rogers, Brown & Co. at their Rabbit Lake property have a mine sufficiently developed to have accumulated a stock pile and if any shipping should be done next year from the district, it will be by that company.

During the season, an important change in organization took place when M. A. Hanna & Co. acquired control of the Pittsburg Iron Ore Co., under which the Nassau mine, at Hibbing, the Croxton, at Chisholm, the Hobart and Brunt, at Mountain, and the LaRue, at Nashwauk, are operated. Of these properties the LaRue and Croxton have been the most active producers. Under the new organization, the Nassau is being developed and Brunt is being stripped. J. D. Ireland, with offices in Duluth, is general manager of all the Hanna properties on the range, having assumed that position during the season. C. E. Hendricks, who had charge of the Hanna mines before the transfer, was made general superintendent, and Alfred Martin, who had been superintendent of the Pittsburg Iron Ore Co. properties, was made assistant superintendent. As a part of the change, the range headquarters of M. A. Hanna will be moved to Virginia, where a new office is now building.

Another organization change was that which made J. H. Hearding, formerly in charge of the Adams and Spruce mines for the Oliver Mining Co., assistant general manager of that company, succeeding John H. McLean, who became general manager. R. J. Mitchell took the position made vacant by Mr. Hearding.

(A review of the year in the Michigan and Wisconsin ranges will be published next week.)

# TWELVE NEW BLAST FURNACES BLOWN IN DURING 1909 IN UNITED STATES

**In Round Figures Country's Pig Iron Producing Capacity Today is 31,000,000 Tons — Interesting Comparisons for Past Five Years — Possible Output for This Year.**

By B. E. V. Luty.

Twelve entirely new blast furnaces, with an annual capacity of 1,930,000 tons, were blown in during 1909 in the United States. The absolutely new blast furnaces blown in during the past five years have been as follows:

| Year | Number | Capacity |
|---|---|---|
| 1905 | 10 | 1,292,000 |
| 1906 | 9 | 1,135,000 |
| 1907 | 15 | 2,065,000 |
| 1908 | 10 | 1,188,000 |
| 1909 | 12 | 1,930,000 |
| Five years | 56 | 7,610,000 |

As has been noted before in these annual reviews of blast furnace construction, only absolutely new blast furnaces, not replacing either old or obsolete furnaces, are considered. The annual ratings are, in general, average ratings, taking into account the necessity of repair and relining; approximately speaking, the average daily capacity for 11 months in the year, allowing one month per year, or three months in three years, for relining and other repairs.

Furnaces grow old and then obsolete; but old furnaces are also repaired or rebuilt, and experience has shown that rebuilding and otherwise improving old furnaces more than makes up for those which are wholly abandoned. The evidence is that the actual growth of blast furnace capacity in the United States is somewhat greater than would be accounted for by the absolutely new furnaces which are here cataloged. Through improvements, harder driving, etc., the performance improves. It may be urged that the leaner character of ores won from old and exploited regions cuts down the output of blast furnaces. Some such result may in time be observed; suffice it to say that it has not appeared in statistics thus far. If it has exerted an influence, the influence has been more than met by the other influences referred to, of harder driving and improvements to old furnaces.

The subjoined list names the entirely new furnaces blown in during the past five years. The sizes and rated capacities are given. It is possible that the personal equation sometimes enters into the estimate of the annual capacity of a furnace; nevertheless the comparison of ratings with sizes is interesting, as varying somewhat in different districts according to the ores to be used, while the variation in size of furnace on account of character of ore, or character of product desired, is also of interest. In general, it may be noted that merchant furnaces intended to make a variety of grades, are as a rule built smaller than steel works furnaces, on account of thus being more manageable.

NEW FURNACES BLOWN IN, 1905-9.

| Date blown in | Name of furnace | Location | Size | Annual Capacity |
|---|---|---|---|---|
| 1905 | | | | |
| Jan. 1 | Pine Lake (Chl.)† | Boyne City, Mich | 60 x 10½ | 29,000 |
| Jan. 3 | Donora No. 1* | Donora, Pa. | 85 x 22 | 150,000 |
| Jan. 21 | Lackawanna No. 4 | Buffalo, N. Y. | 94 x 24 | 180,000 |
| Feb. 7 | Donora No. 2* | Donora, Pa. | 85 x 22 | 150,000 |
| Feb. 22 | Lorain D* | Lorain, O. | 85 x 22 | 150,000 |
| Apr. 28 | Ensley No. 6* | Ensley, Ala. | 87 x 20¾ | 100,000 |
| June 23 | Woodward No. 3† | Woodward, Ala. | 85 x 20 | 90,000 |
| July 5 | Buff.-Susq. No. 2† | Buffalo, N. Y. | 80 x 20 | 113,000 |
| Sept. 3 | Lackawanna No. 5 | Buffalo, N. Y. | 94 x 24 | 180,000 |
| Dec. 28 | Monongahela D* | McKeesport, Pa. | 90 x 22 | 150,000 |
| | Total in 1905, 10 furnaces | | | 1,292,000 |
| 1906 | | | | |
| Jan. 17 | Cambria No. 7 | Johnstown, Pa. | 85 x 22 | 150,000 |
| Jan. 21 | Mingo No. 4* | Mingo Junction, O. | 90 x 21½ | 145,000 |
| Mar. 6 | Cadillac (Chl.)† | Cadillac, Mich. | 60 x 12 | 40,000 |
| May 1 | Lackawanna No. 6 | Buffalo, N. Y. | 94 x 24 | 180,000 |
| June 21 | South Works E* | South Chicago | 90 x 22 | 160,000 |
| Sept. 2 | Joliet No. 4* | Joliet, Ill. | 90 x 22 | 150,000 |
| Sept. 3 | Palmerton No. 2† | Palmerton, Pa. | 70 x 14 | 20,000 |
| Sept. 6 | Midland† | Midland, Pa. | 85 x 21 | 150,000 |
| Oct. 3 | Haselton No. 2 | Youngstown, O. | 85 x 19½ | 140,000 |
| | Total in 1906, 9 furnaces | | | 1,135,000 |
| 1907 | | | | |
| Jan. 1 | Haselton No. 3 | Youngstown, O. | 85 x 20½ | 150,000 |
| Jan. 5 | Toledo No. 2† | Toledo, O. | 80 x 20 | 135,000 |
| Jan. 14 | Josephine† | Josephine, Pa. | 80 x 20 | 140,000 |
| Feb. 1 | Federal No. 1† | South Chicago, Ill. | 75 x 18½ | 110,000 |
| Feb. 12 | Lackawanna No. 7 | Buffalo, N. Y. | 85 x 22 | 180,000 |
| Apr. 22 | Bethlehem E | South Bethlehem, Pa | 90 x 22 | 140,000 |
| May 2 | Mayville B† | Mayville, Wis. | 77 x 17 | 90,000 |
| May 2 | Minnequa F | Pueblo, Colo. | 85 x 20 | 125,000 |
| June 4 | Carrie No. 6* | Rankin, Pa. | 85 x 22 | 160,000 |
| June 16 | Perry† | Erie, Pa. | 75 x 17 | 100,000 |
| Aug. 3 | Carrie No. 7* | Rankin, Pa. | 85 x 22 | 160,000 |
| Aug. 7 | Cambria No. 8 | Johnstown, Pa. | 85 x 21 | 150,000 |
| Aug. 30 | Inland | Indiana Harbor, Ind. | 85 x 19½ | 125,000 |
| Sept. 26 | Lorain E* | Lorain, O. | 90 x 22 | 150,000 |
| Oct. 10 | Monongahela D* | McKeesport, Pa. | 90 x 23 | 150,000 |
| | Total in 1907, 15 furnaces | | | 2,065,000 |
| 1908 | | | | |
| Apr. 30 | Vanderbilt No. 2† | Boyles, Ala. | 80 x 18 | 80,000 |
| June 30 | Harvester No. 3 | South Chicago, Ill. | 90 x 21 | 140,000 |
| Aug. 22 | Miami† | Hamilton, O. | 80 x 18 | 100,000 |
| Oct. 4 | Jisco (Silicon)† | Jackson, O. | 75 x 17 | 28,000 |
| Oct. 16 | Wickwire | Buffalo, N. Y. | 80 x 19 | 100,000 |
| Nov. 2 | Tube A | Youngstown, O. | 88 x 22 | 180,000 |
| Nov. 21 | Ironton† | Ironton, O. | 75 x 18 | 80,000 |
| Nov. 23 | Tube B | Youngstown, O. | 88 x 22 | 180,000 |
| Dec. 21 | Gary No. 10* | Gary, Ind. | 88 x 21½ | 150,000 |
| Dec. 28 | Gary No. 11* | Gary, Ind. | 88 x 21½ | 150,000 |
| | Total in 1908, 10 furnaces | | | 1,188,000 |
| 1909 | | | | |
| Jan. 15 | Gary No. 12* | Gary, Ind. | 88 x 21½ | 150 000 |
| Feb. 11 | Ohio No. 5* | Youngstown, O. | 95 x 23 | 182,500 |
| Mar. 17 | Duquesne No. 5* | Duquesne, Pa. | 95 x 22 | 182,500 |
| June 13 | Gary No. 9* | Gary, Ind. | 88 x 21½ | 150 000 |
| June 29 | Ohio No. 6* | Youngstown, O. | 95 x 23 | 182,500 |
| July 14 | N. Y. State | Buffalo, N. Y. | 85 x 21 | 150,000 |
| July 15 | Federal B† | South Chicago, Ill. | 80 x 20 | 125,000 |
| Aug. 11 | Duquesne No 6* | Duquesne, Pa. | 95 x 22 | 182,500 |
| Sept. 20 | Cleveland No. 2† | Cleveland, O. | 90 x 22 | 150,000 |
| Nov. 20 | Gary No. 8* | Gary, Ind. | 88 x 21½ | 150 000 |
| Dec. 1 | Aliquippa No. 1 | Aliquippa, Pa. | 90 x 22 | 175,000 |
| Dec. 4 | Gary No. 7* | Gary, Ind. | 88 x 21½ | 150,000 |
| | Total in 1909, 12 furnaces | | | 1,930,000 |

†Merchant furnaces.
*United States Steel Corporation furnaces.
A few names have been furnished by the writer to furnaces which appeared to lack them.
The distribution as to ownership of the above furnaces is as follows:

| | Number. | Capacity. | Percentage. |
|---|---|---|---|
| U. S. Steel Corporation | 22 | 3,405,000 | 44.7 |
| Independent steel works | 17 | 2,625,000 | 34.5 |
| Merchant interests | 17 | 1,580,000 | 20.8 |
| Total | 56 | 7,610,000 | 100.0 |

## Furnaces Being Built.

Including only furnaces which are definitely in course of erection, the following may be noted:

The Republic Iron & Steel Co. is building a fourth furnace at the Haselton group, Youngstown, O., to be completed before July 1.

The River Furnace & Dock Co., Cleveland, O., allied with Corrigan, McKinney & Co., was incorporated in January, 1909, and in March let contracts for two furnaces; one is expected to be in blast in February and the other at a later date; for tabular purposes this article will take the liberty of applying the name "River" to these furnaces.

The Detroit Iron & Steel Co. is completing a second merchant stack on Zug island, Detroit, Mich., which will probably be in blast in February.

The Wickwire Steel Co., Buffalo, N. Y., is building a second furnace on Rattlesnake island, near Buffalo, which will probably be in blast in July.

The East Jordan Furnace Co., East Jordan, Mich., is completing a charcoal stack, which will probably be completed in January. It is understood that the product has been sold for a term of years to the American Car & Foundry Co.

The Bethlehem Steel Co. in October, 1909, let contracts for two new furnaces, to be known as F and G, which will probably be completed some time after July 1. The furnace D, which the company will probably complete in February, is understood to replace a former number, and for conservatism is not included in the summary.

Worth Brothers Co., Coatesville, Pa., which manufactures open-hearth steel but has not hitherto made pig iron, is building a furnace which is expected to be in blast about Feb. 1; early in October, 1909, it broke ground for a second furnace, which will follow at a later date.

The Youngstown Sheet & Tube Co. in September, 1909, broke ground for a third furnace at Youngstown, which is expected to be completed some time before July 1.

In December, 1909, the American Steel & Wire Co. was authorized to build No. 4 furnace at the Central group, Cleveland, O.

The Jones & Laughlin Steel Co., which blew in its first Aliquippa furnace Dec. 1, 1909, has two companion furnaces almost completed; a fourth furnace is much less advanced.

The Indiana Steel Co. at this writing has practically completed the two remaining of the eight Gary furnaces authorized, and is ready to blow them in at almost any time.

Summarizing the foregoing furnaces, which are practically certain to be completed ready for blowing in during the first three quarters of this year, designating the merchant stacks by (†) and the Steel Corporation stacks by (*) as in the preceding table, the following appears:

| | Annual capacity. |
|---|---|
| First quarter: | |
| Gary No. 5* | 150,000 |
| Gary No. 6* | 150,000 |
| River No. 1† | 140,000 |
| Zug No. 2† | 100,000 |
| E. Jordan (Chl.)† | 24,000 |
| Worth No. 1 | 120,000 |
| Aliquippa No. 2 | 175,000 |
| Aliquippa No. 3 | 175,000 |
| Eight furnaces | 1,034,000 |
| Second quarter: | |
| Haselton No. 4 | 150,000 |
| Tube No. 3 | 180,000 |
| Two furnaces | 330,000 |
| Third quarter: | |
| River No. 2† | 140,000 |
| Wickwire No. 2 | 140,000 |
| Bethlehem F | 140,000 |
| Bethlehem G | 140,000 |
| Worth No. 2 | 120,000 |
| Central No. 4* | 175,000 |
| Six furnaces | 855,000 |

Grand total, 16 furnaces, 2,219,000 tons annual capacity.

### Prospective Total Capacity.

It is now in order to seek means to ascertain the present and prospective pig iron producing capacity of the country. It is well known that the capacity cannot be predicated upon the sum total of the ratings of all the furnaces in the country. Some capacities are over-stated, and many furnaces are technically in the producing class but practically they do not produce. There is nothing, then, but to take actual performance. New furnaces are continually coming in and adding their contributions for various portions of the year in which they first appear. There is nothing to do, then, but to subtract the output of the new furnaces in order to arrive at the foundation. This can be done, for the output of the new furnaces is fairly well known, and in any event one is estimating the smallest factor. It will be recalled that from about the close of 1904 until nearly the close of 1907 the blast furnaces of the country were continuously under full pressure, and may be assumed to have done the best they could. Inasmuch as we have a complete list of the new blast furnaces which came in during this period, and official statistics of the actual production by half years, let us deduct the contribution of the new furnaces and see what the old furnaces did. A simple chart devised by the writer permitted a quick computation of the contribution which each new furnace, coming in during a half year, would make to that half year's output. The following table has been constructed by this means. It shows what it may reasonably be assumed the new furnaces contributed to the country's output, by half years, from Jan. 1, 1905, to June 30, 1907, a period during which it is fair to assume the old furnaces made all the pig iron they could. It will be observed that to the half year in which they were blown in the furnaces contributed a portion of their capacity; to succeeding half years, of course, it is assumed they contributed full output.

The balance in the above table represents approximately the output of the old furnaces, in existence prior to Jan. 1, 1905. What is remarkable about the showing is that the output of these old furnaces appears to have increased 400,000 tons from the first half of 1905 to the second half of that year, and then to have made a further increase of 430,000 tons to the first half of 1906. In the next half year, the second half of 1906, there was a decrease of 230,000 tons, but the following half year, the first half of 1907, there was an increase again, of 277,000 tons.

It is usually assumed that after a period of depression, such as that in 1903-4, the furnaces for a while do unusually well, an abnormal number having been relined and otherwise repaired, so that in the early part of a period of sustained demand they do above their normal, and in the latter part of it they do below their normal. If the rule was in force in the above instance one must admit the working of other forces which covered up its results. Granting the rule worked, the increased production shown is the more noteworthy. Either quite a number of furnaces which were productive in 1905 were idle in 1905, particularly in the first half, or through rebuilding, harder driving or what not the furnaces made much better outputs in the second portion of the period.

However the showing is explained, one must grant that what the old furnaces did from July 1, 1906, to June 30, 1907, represented what they could do at any time under fair conditions. This, then, gives us our basis of capacity for the country, subject to additions for new furnaces, and it is worth all the trouble involved to reach it, for information as to the new furnace capacity of the country is of relatively little value unless we know to what that capacity is being added.

The actual output, according to official figures, July 1, 1906, to June 30, 1907, was 26,303,985. The new furnaces blown in during the second half of 1906 produced about 119,000 tons in that half year, and about 235,000 tons in the first half of 1907. The new furnaces blown in during the first half of 1907 produced about 360,000 tons in that half year, the total of these being 714,000 tons. Deducting this from the actual make, 26,202,985 tons, leaves 25,488,985 tons, or, in round figures, 25,500,000 tons, which we may set down as the proved annual capacity of the furnaces which were completed July 1, 1906.

CONTRIBUTION OF NEW FURNACES.

| Blown in during— | First half, 1905. | Second half, 1905. | First half, 1906. | Second half, 1906. | First half, 1907. |
|---|---|---|---|---|---|
| First half, 1905 | 338,000 | 487,000 | 487,000 | 487,000 | 487,000 |
| Second half, 1905 | ..... | 119,000 | 256,000 | 256,000 | 256,000 |
| First half, 1906 | ..... | ..... | 185,000 | 440,000 | 440,000 |
| Second half, 1906 | ..... | ..... | ..... | 119,000 | 235,000 |
| First half, 1907 | ..... | ..... | ..... | ..... | 360,000 |
| Total contribution | 338,000 | 606,000 | 928,000 | 1,302,000 | 1,778,000 |
| Country's output | 11,163,175 | 11,829,205 | 12,582,250 | 12,724,941 | 13,478,044 |
| Balance | 10,825,175 | 11,223,205 | 11,654,250 | 11,422,941 | 11,700,044 |

This, then, is our foundation, proved by actual performance after the furnaces had been under the pressure of prosperity for from one and a half to two and a half years. Experience having shown that the old furnaces do better year by year, through rebuilding, etc., and knowing that in the past two years a considerable number of old furnaces have been rebuilt and otherwise improved, some even now undergoing such improvement, we may proceed with confidence to compute actual capacity at different dates, as below:

| | |
|---|---|
| Actual capacity, July 1, 1906 | 25,500,000 |
| New furnaces, July 1, 1906, to Dec. 31, 1907 | 2,375,000 |
| Capacity, Jan. 1, 1908 | 27,875,000 |
| New capacity in 1908 | 1,188,000 |
| Capacity, Jan. 1, 1909 | 29,063,000 |
| New capacity in 1909 | 1,930,000 |
| Capacity, Jan. 1, 1910 | 30,993,000 |

In round figures, then, the capacity Jan. 1, 1910, is 31,000,000 tons. Our furnace reports have shown the country to be making pig iron at a greater rate than that. We may assume that the discrepancy tends to prove the conservatism of our figures, and at the same time proves the justice of the claim made in well informed quarters that such a disproportionate number of furnaces has been relined and otherwise gotten into good shape that the recent pace of pig iron production is one which could not be maintained without further accretions to the ranks. Year in and year out, we believe the existing furnaces could just comfortably maintain an average rate of 31,000,000 tons.

As to prospective capacity, we found we had the following new capacity due in 1910:

| | |
|---|---|
| First quarter | 1,034,000 |
| Second quarter | 330,000 |
| Third quarter | 855,000 |

With 30,993,000 tons capacity Jan. 1, April 1 would find 32,027,000 tons; July 1 would find 32,357,000 tons, and Oct. 1 would find 33,212,000 tons.

### Possible Production in 1910.

What the country will make in 1910 no one can predict with any certainty. What it would be physically possible for the furnaces to produce can be computed with considerable precision. Recent performances showed a rate which with the new furnaces blown in toward the close of the year would make a rate of 32,-

000,000 tons a year, but part of the good performance was due to good weather conditions and part to the furnaces, as a whole, being in particularly good shape. For a full year's performance these same furnaces could not make 32,000,000 tons, probably not 31,500,000 tons. Assuming the new furnaces of 1910 to become productive at the middle of the quarters to which they have been assigned, they could contribute, figuring precisely, 1,430,000 tons, and from these data we may assume the physical capacity of the blast furnace industry in the United States for the year 1910 at approximately 33,000,000 tons. It is improbable that they could make materially more than this under the best conditions, or that if they had the incentive to run they would be likely to fall very greatly below this tonnage.

It is to be noted that the 33,000,000 tons we assume as the possible make for 1910 is approximately the same as the capacity found for Oct. 1 of the year. The approximate coincidence is due to the fact that in figuring capacity on Oct. 1 we assume a conservative rating for the furnaces, allowing for relining, etc., whereas for the calendar year's possible output we start the existing furnaces at what may be considered something above their normal rating, on account of their being in particularly good condition for a time. Without additional furnaces the country could not make much more iron in 1911, probably, than in 1910.

### The Rule of Doubling.

According to the temperament of the individual, a capacity for making approximately 33,000,000 tons of pig iron in 1910 may or may not seem large. Hitherto our production has doubled, on an average, once in just a few months less than 10 years. The rule is well established, by careful comparisons, but it cannot be applied at random, on account of the wide fluctuations in output from one year to another. The decennial years after 1870 were all record breakers in their time. To double production every 10 years would make the 1910 output eight times that of 1880, four times that of 1890 and twice that of 1900. The idea is carried out below:

| | | | | |
|---|---|---|---|---|
| 1880 ..... | 3,835,181 | × 8 | = | 30,681,528 |
| 1890 ..... | 9,202,703 | × 4 | = | 36,810,812 |
| 1900 ..... | 13,789,242 | × 2 | = | 27,578,484 |

Thus 33,000,000 tons for 1910 would not fall out badly at all; it would be too much compared with 10 or 30 years ago, but too little compared with 20 years ago. Perhaps these are vain speculations, but they may serve somewhat to lighten the tedium of the figures which have been presented. If there is anything cyclical about the course of the iron industry, and there are some good reasons for believing that there is, the movement is in a 20-year cycle. Grant that, and the comparison of 1910 must be made with 1890, whereupon it appears that the 33,000,000 tons is short of what we might have expected!

### Where the Iron Goes.

We have traced altogether the addition of 7,610,000 tons of absolutely new pig iron producing capacity in the five years 1905-9, inclusive, with about 2,200,000 tons to come in during the first three quarters of 1910. Only 20.8 per cent of the addition in the past five years was in merchant capacity. In considerable measure the smallness of the addition was due to the fact that the steel works were building furnaces of their own to make them independent of the merchant furnaces. Some merchant capacity has thus been released to devote itself to the foundry trade. There is no doubt, however, that the consumption of pig iron has increased more rapidly for steel making than for foundry purposes.

At the same time that some steel interests have been building furnaces of their own to make themselves independent of the merchant furnaces, like the Steel Corporation itself in the early days, and like the International Harvester Co., Inland Steel Co., Youngstown Sheet & Tube Co., Wickwire Steel Co., and New York State Steel Co. in later days, these concerns having been buyers of merchant iron only as they prepared to round out their plans, other steel interests have sprung up or have increased their capacity, furnishing a fresh demand for merchant steel making iron. Among these may be mentioned the Pittsburg Steel Co., Page Woven Wire Fence Co., Allegheny Steel Co., West Leechburg Steel Co., West Penn Steel Co., Sharon Steel Hoop Co., American Rolling Mill Co., and several others, besides a large number of open-hearth steel casting interests. Several of the concerns just mentioned are increasing their capacity at the present time, while the Forged Steel Wheel Co., at Butler, Pa., will bring in a new plant of six open-hearth furnaces about April 1. It is not impossible that the merchant capacity may be found lacking in 1910, if demand continues good all along the line. It is a dictum in the trade that the foundry business picks up, in a general revival, about six months later than the steel industry proper. The merchant furnaces have found much employment of late in furnishing Bessemer iron to established steel works, which had been supposed to be fairly well supplied by production of their own, and should this demand be continued in large measure, and an increased demand for foundry iron appear, the merchant furnaces might find their hands full. Of the 16 furnaces being built at the present time only four are merchant stacks, and one of these is a charcoal furnace. Excluding the charcoal stack entirely, the merchant capacity due in the first nine months of 1910 is only 17 per cent of the combined merchant and steel works furnace capacity.

A portion of the erection of new furnaces by steel works of late has been, as noted, to make the steel works independent of merchant production. Another portion has been to provide for harder driving and minor additions in the case of steel works. Another portion has been to cover distinct and important new erection. Thus the two new Duquesne furnaces are largely to make up the difference between the Bessemer department which was abandoned and the 18 new open-hearth furnaces which have lately been added; the two Ohio furnaces have been largely to take care of 12 open-hearth furnaces erected at Youngstown, while the eight Gary furnaces were authorized at the same time as 56 open-hearth furnaces, and additional Gary blast furnaces will doubtless be built before additions are made to the open-hearth department. At the present time Gary is running 28 of the 56 open-hearth furnaces, and also seven of the eight blast furnaces. The Aliquippa furnaces of the Jones & Laughlin Steel Co. are partly to take care of the company's enlarged Pittsburg plant, the open-hearth capacity authorized at Aliquippa comprising four 200-ton Talbot furnaces, which will doubtless leave a surplus of pig iron for the Pittsburg plant. The new Haselton No. 4, of the Republic Iron & Steel Co., is in connection with the six 50-ton open-hearth furnaces which the company is adding, marking this company's entrance into the open-hearth field.

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**The Anaconda Copper Co. has declared the usual quarterly dividend of 50 cents a share, payable Jan. 19.**

# QUICK CHANGE IN PRICES OF COKE

**Was a Striking Feature of the Year – Overproduction for Many Months and Low Prices Followed by Reversal of Conditions.**

Probably no market of the year has shown so abrupt a reversal from low to high prices as that of coke. Prices continued about stationary over the first seven months of the year due to the large reserve oven capacity in the Connellsville regions, which was gradually fired as blast furnace activities increased with the recovery in the iron and steel market. The first four months saw production in the Connellsville regions fluctuate within narrow bounds, but from May to the end of the year there was a sustained upward movement in output. The increased demand, however, appeared scarcely proportionate to the idle oven capacity that was constantly coming into blast, and prices received no buoyancy from this influence during the months of May, June and July. On the contrary, a state of over-production appeared to prevail in the Connellsville district, and in the efforts of operators to keep their plants going, price concessions were granted. High grade standard coke sold down to $1.50, ovens, and this level was shaded in some cases. The sharp rising movement of pig iron production in August brought a decided change in the coke situation, and prices began to rapidly advance. This recovery was maintained to the year's close, and in the interval a rise in selling values of $1.35 a ton was recorded. The United States Steel Corporation was a factor in this development, as it entered the market and purchased approximately 100,000 tons for delivery over the final four months. The highest point reached in the year was $3, ovens, on contract in a few rather extraordinary cases, and a large tonnage was disposed of at $2.90, ovens.

One of the largest coke transactions of the year was that closed by the Jones & Laughlin Steel Co. with the Thompson-Connellsville Coke Co. for the requirements of its new Aliquippa group of furnaces. The contract is for a period of three years and began to run Nov. 1. Immediately upon the closing of this transaction, the seller began the erection of a block of 400 additional ovens, which were fired later in the year. A notable contract in foundry coke calling for about 55,000 tons for the two year requirements of a large western harvester interest was negotiated by a Pittsburg interest in February. A large number of sliding scale contracts were made in the year, many of these upon the accustomed basis of Bessemer iron, but there was an increased disposition to adopt basic iron as the standard in these negotiations. Probably more coke contracts based upon basic iron were made in 1909 than in any other previous year, and this was mainly during the first half before the advance in Bessemer iron had surpassed that of basic.

An important incident of the year in the coke market was the effort to consolidate the independent ovens of the upper and lower Connellsville regions into one large operating corporation. Options up to Oct. 1 were taken upon many plants, but the sharp recovery of the market at about this time and the inability of the promoters to finance the enterprise, caused its abandonment.

Labor shortages in the operating regions were a factor of importance when the industry reached an active state. Many of the laborers during the depression had left the region and the country, and it required a considerable time to bring in an adequate supply and to adjust the industry to the changed conditions. Water shortages at times also caused considerable annoyance. The higher coke prices gave an impetus to the completion of partly-developed plans for oven construction and a number of new extensions were launched. At the close of the year, the total number of ovens listed in the Connellsville regions was more than 1,400 greater than Jan. 1, 1909.

With the last week of the year estimated, the total production of coke in the upper and lower Connellsville regions in 1909 was 17,361,958 net tons compared with 10,700,022 net tons in 1908 and 19,029,058 net tons in 1907. The highest mark ever reached in the Connellsville territory was in 1906, when the total output was 19,999,326 net tons. The rate of weekly production during the last five months of the year 1909, which averaged slightly over 425,000 net tons, was at the highest point in the history of the industry.

The average monthly prices on spot standard Connellsville coke by months over the year 1909 were as follows:

CONNELLSVILLE COKE PRODUCTION.
(Compiled from the weekly reports of the Connellsville *Courier*.)

| Week 1909. | Ovens. | In blast | Out blast. | Tons. |
|---|---|---|---|---|
| Jan. 9.... | 37,842 | 23,653 | 14,189 | 265,158 |
| Jan. 16.... | 37,845 | 23,478 | 14,367 | 262,440 |
| Jan. 23.... | 37,845 | 23,598 | 14,247 | 267,709 |
| Jan. 30.... | 37,855 | 23,564 | 14,291 | 265,514 |
| Feb. 6.... | 38,111 | 24,112 | 13,999 | 262,156 |
| Feb. 13.... | 38,111 | 24,066 | 14,045 | 268,958 |
| Feb. 20.... | 38,207 | 24,002 | 14,205 | 265.619 |
| Feb. 27.... | 38,207 | 24,044 | 14,163 | 268,852 |
| Mar. 6.... | 38,205 | 23,218 | 14,987 | 260,987 |
| Mar. 13.... | 38,207 | 22,836 | 15,371 | 252,617 |
| Mar. 20.... | 38,207 | 23,122 | 15,085 | 251,261 |
| Mar. 27.... | 38,100 | 22,558 | 15,542 | 237,741 |
| Apr. 3.... | 38,100 | 22,273 | 15,827 | 245,450 |
| Apr. 10.... | 38,120 | 22,068 | 16,052 | 233,718 |
| Apr. 17.... | 38,120 | 22,108 | 16,012 | 233,151 |
| Apr. 24.... | 38,120 | 21,804 | 16,316 | 230,229 |
| May 1.... | 38,120 | 21,665 | 16,455 | 229,507 |
| May 8.... | 38,120 | 22 216 | 15,904 | 244,279 |
| May 15.... | 38,120 | 22,650 | 15,470 | 252,485 |
| May 22.... | 38,328 | 24,090 | 14,238 | 278,729 |
| May 29.... | 38,328 | 24,646 | 13,682 | 284,866 |
| June 5.... | 38,324 | 25,100 | 13,224 | 291,686 |
| June 12.... | 38,324 | 27,770 | 10,554 | 299,486 |
| June 19.... | 38,325 | 28,069 | 10,256 | 307,014 |
| June 26.... | 38,478 | 28,665 | 9,813 | 320,634 |
| July 3.... | 38,478 | 28 777 | 9,701 | 324,181 |
| July 10.... | 38,476 | 29,683 | 8,793 | 290,467 |
| July 17.... | 38,476 | 30,129 | 8,347 | 384,425 |
| July 24.... | 38,476 | 30,274 | 8.202 | 385,452 |
| July 31.... | 38,476 | 30,372 | 8,104 | 385,817 |
| Aug. 7.... | 38,477 | 30,542 | 7,935 | 395,664 |
| Aug. 14.... | 38,483 | 30,829 | 7,654 | 395,188 |
| Aug. 21.... | 38,483 | 30,962 | 7,521 | 397,979 |
| Aug. 28.... | 38,558 | 32,131 | 6,427 | 416,354 |
| Sept. 4.... | 38,558 | 32,474 | 6,084 | 421,320 |
| Sept. 11.... | 38,559 | 32,728 | 5,831 | 424,568 |
| Sept. 18.... | 38,559 | 32,917 | 5.642 | 426,648 |
| Sept. 25.... | 38,559 | 33,092 | 5,467 | 418,956 |
| Oct. 2.... | 38,559 | 34,693 | 3,866 | 423,819 |
| Oct. 9.... | 38,559 | 35,293 | 3,866 | 437,829 |
| Oct. 16.... | 38,674 | 34 122 | 4,552 | 428,313 |
| Oct. 23.... | 39,034 | 34,500 | 4,534 | 442.326 |
| Oct. 30.... | 39,034 | 34,706 | 4,328 | 450,768 |
| Nov. 6.... | 39,070 | 34,742 | 4,328 | 456,055 |
| Nov. 13.... | 39,189 | 35,268 | 3.921 | 458,329 |
| Nov. 20.... | 39,207 | 35,021 | 4,186 | 412,156 |
| Nov. 27.... | 39,207 | 35,366 | 3,841 | 445,988 |
| Dec. 4.... | 39,227 | 35,338 | 3,889 | 444,610 |
| Dec. 11.... | 39,227 | 35 412 | 3,815 | 438,765 |
| Dec. 18.... | 39,263 | 35,753 | 3,510 | 452.735 |
| Dec. 25.... | 39,255 | 35,711 | 3,544 | 374,554 |
| Jan. 1.... ..... | ..... | ..... | ..... | *425.000 |
| Total production ..... | | | | 17,361,958 |

*Estimated.

## PREPARING TO BUILD.

The Toledo Machine & Tool Co., of Toledo, O., reports a constantly increased demand for its punch presses, drop hammers and power-squaring shears. Early in the year 1909 it added 65,000 feet of additional floor space, which has been equippel with a number of machine tools. More ground was recently purchased and plans are now being made for the erection of additional buildings with a floor space of about 100,000 square feet.

## ADDING TO ITS PLANT.

The American Steel Foundries has let contracts for additions to be built to its plant at Indiana Harbor, Ind. One building, to be used as a foundry, will be 118 x 620 feet; another for a brick storehouse, 54 x 100 feet. The larger building will be employed for the manufacture of small castings exclusively, and an electric furnace will be installed in it. The force of workmen will be doubled when the new buildings are completed.

The Colorado Fuel & Iron Co. is producing 500 tons of iron ore daily at its Fierro, New Mex., mine.

# THE MOST ECONOMICAL POWER FOR SMALL AND MEDIUM-SIZED IRON AND STEEL WORKS

## A Comparison of Steam, Electric and Gas Power as Applied to Existing Plants

By J. A. Knesche.

### Problem.

Given two blast furnaces, a Bessemer steel works, a rolling mill and another department which we will call department "T" requiring about 1,200 horsepower; in this department "T" the semi-finished steel coming from the rolling mills is manufactured into a finished product. What this manufactured product is, whether pipe, nails, wire or some other steel product is immaterial for our present purpose which is to determine the cost of power for a metallurgical works having the above-mentioned departments, if the low-pressure turbine is made use of; also to compare the proposed low-pressure turbine installation with the existing steam equipment and with a proposed gas-electric installation.

### Description of Plant and Some Phases of Its Power Requirement.

We shall describe this metallurgical works as one which had its beginning say thirty years ago, of which many departments have been remodeled several times and to which many additions have been made. This plant turns out a fairly good tonnage but it is not strictly modern. The writer believes that there are a number, perhaps many, metallurgical works of this kind.

The brake horsepower required for the normal operation of the works under consideration is about 9,750. Our first problem will be to see to what extent the power can be cheapened in these works if same were to be generated by a combination of engine and low-pressure turbines. There would be of course great possibilities if all the surplus furnace gas were used in gas engines driving electric generators. However, the outlay required for a gas-engine electric installation is much greater than is required for the low-pressure steam turbine installation proposed in this case and this first outlay is an important factor when appropriations for improvements are to be made. This greater outlay required for a complete gas-engine electric installation in such a plant as the one under consideration is due to the fact that the entire existing steam equipment becomes practically useless. With the changes as proposed in this paper this will not be the case since more than one-half of the present power-generating equipment will be retained. Furthermore, many metallurgical works of the older type have two furnaces only and these perhaps are a great distance apart, a condition almost invariably true where the works have grown from small establishments to plants of considerable size; in such plants it is not always possible to derive as great a gain from the installation of a gas-engine electric equipment as the large volume of gas at first sight might lead one to believe. The reason for this is that the prime requisite for an efficiently operated iron and steel works is its continuous operation, and for this continuous operation a continuous supply of power is absolutely essential. Now it is evident to anyone familiar with blast-furnace operations that it is impossible to obtain from the furnaces at all times the maximum quantity of blast-furnace gas, because of irregularities in furnace operations, stops of shorter or longer duration, etc. Therefore in planning a gas-engine electric equipment for a plant with two furnaces only it would be a wasteful expenditure of money to install sufficient gas-engine equipment for the production of power from all the gas obtained under the most favorable operating conditions of the blast furnaces even if the power thus generated were needed. If one furnace is smaller than the other, one say 300 and the other 400 gross tons capacity per 24 hours the reliable continuous supply of power can not be taken at more than the gas generated in the production of a tonnage of iron 10 per cent less than that of the smaller furnace or about 270 gross tons. A tonnage 10 per cent less than the normal of the smaller furnace must be taken because it may happen that the large furnace is out of operation for re-lining or banked for some reason while at the same time the smaller furnace may not be making full tonnage.

### Some Preliminary Calculations.

Thus taking into consideration that while most of the time there may be available a large volume of gas which if used in gas engines would furnish all and perhaps even more than the power required for the entire plant, yet the constant quantity of gas obtainable at certain times is much smaller, and the gas-engine installation is limited to this smaller constant quantity of gas.

The total horsepower required for operating the plant in question is 9,750. The two furnaces belonging to this plant produce per 24 hours 700 gross tons of iron. In order to get the most out of the present steam equipment in the installation under consideration it is proposed to operate the steam blowing engines of one of the blast furnaces non-condensing and to use the exhaust steam to drive low-pressure turbo generators.

The question might be asked here, if an economy will result by operating the blowing engines of one furnace in combination with low-pressure turbines, why not operate the blowing engines of the other furnace likewise in connection with low-pressure turbines? The answer to this question is simple, namely, because we would have no use at the plant in question for all the power thus generated. While it will be seen as our problem develops that more power will be required than the low-pressure turbo station of one furnace will yield, it will be advantageous to make use of the exhaust steam of some other department instead of that from the steam machinery of the other furnace.

The water coming from the furnace boshes will be used as part of the condensing water in the low-pressure turbine station and again as boiler feed water.

As stated before we have a blast-furnace which produces on an average of 300 gross tons of iron per 24 hours and one with an average daily tonnage of 400 gross tons. The two furnaces are nearly half a mile apart. Under existing conditions it is advisable that the exhaust steam of another department located near the small furnace be used in connection with low-pressure turbines; further, since it would be difficult to find a use for the additional power generated in a low-pressure turbo station using the exhaust from the steam machinery of the large furnace, it is proposed to leave the compound condensing blowing engines of the larger furnace as they are.

For the smaller furnace we could count on an average production of $(300 \times 150{,}000) \div 24 = 1{,}875{,}000$ cubic feet of gas per hour. Allowing the usual 30 per cent of gas for the hot

blast stoves would leave 1,875,000 minus 562,500 or 1,312,500 cubic feet.

The power required for this furnace is as follows:

| | | |
|---|---|---|
| Blowing engines | 1,300 | horsepower |
| Skip hoist engine | 100 | " |
| Pumps | 25 | " |
| Electric light and power | 25 | " |
| Blast-furnace bells and misc. purposes | 50 | " |
| Total | 1,500 | horsepower |

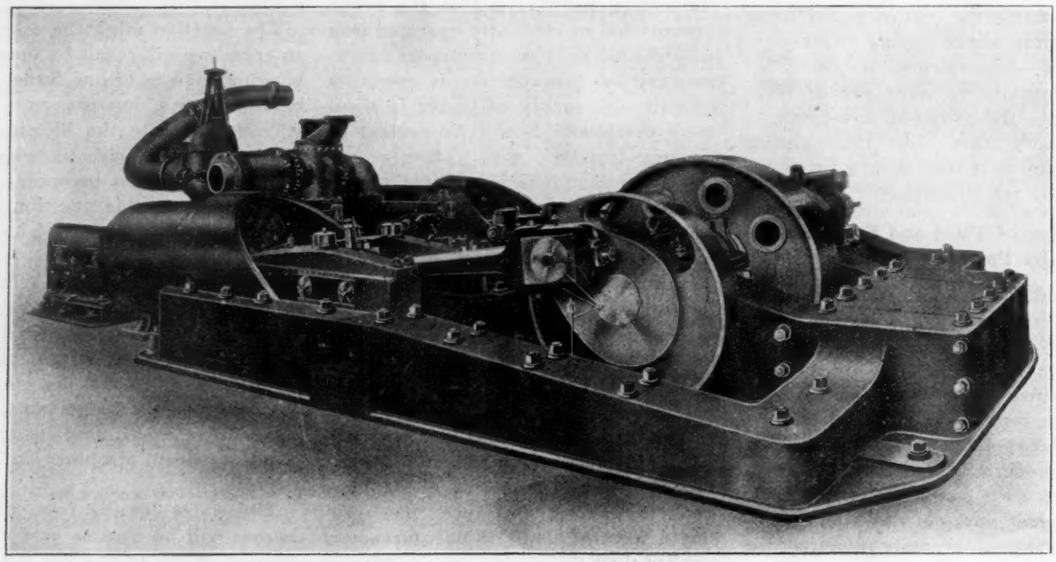
The average steam consumption at this furnace is 40 pounds per individual horsepower per hour and this gives a total steam consumption of 60,000 pounds per hour. With the proposed installation of low-pressure turbines assuming that the feed water will be heated to 150 degrees Fahrenheit only, that there is an average boiler efficiency of 60 per cent, a boiler pressure of 110 pounds and 90 B. t. u. per cubic foot of blast-furnace gas there would be required per hour for the generation of the 60,000 pounds of steam (1,037 × 60,000) ÷ (.60 × 90) or 1,150,000 cubic feet of blast-furnace gas. For the sake of clearness a resumé is given of the figures worked out for this smaller of the two blast-furnaces in Table I.

TABLE I.

(Showing available surplus gas for the smaller of the two furnaces.)

| | | |
|---|---|---|
| Average total gas generated per hour in cubic feet... | | 1,875.000 |
| Required per hour for stoves in cubic feet..... | 562,500 | |
| Required per hour for furnace steam machinery in cubic feet..... | 1,150,000 | 1,712,500 |
| Surplus gas available for outside purposes in cubic feet per hour ..... | | 162,500 |

The average surplus gas for outside purposes at this furnace is thus 162,500 cubic feet per hour which does not seem to be very much but is too much to waste. In the proposed rearrangement of the power plant it is not intended to scrap the existing steam engines if good use can be found for any of the old equipment. The 162,500 cubic feet of gas would generate 262 horsepower in a steam engine. The easiest way to make good use of the surplus furnace gas is to burn it under boilers, the steam being used to drive an engine generator operating in parallel with the low-pressure turbo installation. The exhaust from this engine would be used in the low-pressure turbines. There is available a 250 horsepower engine driving at present an electric generator. It is proposed to fit this engine with a new generator and operate it in parallel with the low-pressure turbine plant. If a new engine were to be installed it would be the part of wisdom to install a compound engine, but since the saving in steam in the case of a compound engine run in connection with a low-pressure turbine as compared with an economical single expansion engine run in connection with a low-pressure turbine, will not be more than 15 per cent, or 16 per cent, it would be unwise not to make use of the old single expansion engine in question.



50 x 60 Inch Twin Cylinder, Reversing Engine; Mackintosh, Hemphill Co.

### Provisional Calculation for the Low-Pressure Turbine Installation at the Smaller Furnace.

The real saving factor in this entire rearrangement of the power department will be the low-pressure turbines. These will make use of something which has heretofore been thrown away.

Th exhaust steam from the blowing engines and the skip hoist engine will be available for the low-pressure turbines. This available steam would make 1,400 horsepower. The total horsepower required for the furnace is 1,500; but since some exhaust steam will be needed for heating the feed water our calculations for the available low-pressure steam from the furnace machinery have been based on 1,400 horsepower only. There is further available the exhaust steam from the 282 horsepower generated with the surplus furnace gas. We will have therefore, not counting condensation losses, from the furnace machinery 56,000 pounds and from the engine using the steam from the surplus furnace gas 8,460 pounds or an average total of 64,460 pounds of low-pressure steam per hour. Since about 15 per cent of the above exhaust steam is lost through condensation we would have at the low-pressure turbines 54,600 pounds. This exhaust steam would develop in a low-pressure turbine 1,920 horsepower. Therefore the total power which it would be possible to generate and which power must be considered reliable at all times because of the ability to use coal instantly in case the gas should give out, would be as follows:

| | | |
|---|---|---|
| Furnace machinery | 1,500 | horsepower |
| From surplus gas | 282 | " |
| Low-pressure turbines | 1,920 | " |
| Total | 3,702 | horsepower |

### Blooming Mill.

The blooming mill in the metallurgical works under consideration is of the reversing type. The writer does not believe in electrically driven reversing mills as a rule unless a demand must be created for a great and reliable quantity of very cheap electric energy. His main reasons for this belief are the high first cost of the installation which is about three times that of a first class modern reversing engine; and further of the great complexity resulting when three large electric units must be in-

stalled with the apparatus necessary, as compared with the steam engine. The chances for "being down" waiting on necessary repairs are much greater with the former than with the latter. This possible greater delay in making tonnage with the electric installation when compared with the steam engine installation, together with the high first cost, make a very cheap supply of electrical energy absolutely essential if an electrically reversing mill is to be installed. To the writer's knowledge reversing blooming mill engines are now in operation that show an average steam consumption as low as 32 pounds of steam per horsepower hour of normal mill operation. Such an engine fitted with a steam regenerator and low-pressure turbine would be operating more economically than a reliable electric drive. Even after the cost of the regenerator and the low-pressure turbine installation are added to the cost of the reversing blooming mill drive the first cost would scarcely be more than one-half of the cost of the electric installation.

Now in the metallurgical works under consideration, which is to make a full use of all its blast-furnace gas and its exhaust steam, there is a blooming mill engine in operation which develops an average of 700 horsepower during normal operation on an average steam consumption of 65 pounds per hour. This engine was built years ago. In addition there are compound high pressure pumps in operation furnishing pressure for hydraulically operated machinery; these pumps aggregate a total of 200 horsepower. The blowing engines of the converting department of the Bessemer steel works aggregate 900 horsepower. It is proposed to leave this steam equipment as it is and to make a full use of the exhaust steam by installing a steam regenerator with a low-pressure turbine. Most readers of THE IRON TRADE REVIEW are probably familiar with the Rateau steam regenerator and its application and consequently a description is not necessary. Those not familiar with it are referred to Prof. Rateau's lecture before the Society of Belgian Engineers, in 1907; to Mr. F. G. Gasche's article in "Power," June, 1907; to Mr. Henry H. Wait's paper, "An Exhaust Steam Turbine Plant," presented before the A. I. E. E. on Dec. 13th, 1907, etc.

The total steam per hour required for this steam equipment mentioned in the preceding paragraph will then be as follows:

| | | |
|---|---|---|
| Blooming mill | 45,500 | pounds |
| Hydraulic pumps | 13,000 | " |
| Blowing engines | 36,000 | " |
| Total | 94,500 | pounds |

If we allow again 15 per cent for loss through condensation we would have 80,325 pounds of exhaust steam for the low-pressure turbines. With this steam we would be able to generate in the turbines 2,868 horsepower. For the sake of a clear survey of the entire problem we present in Table II a summary of the total power to be generated.

TABLE II.

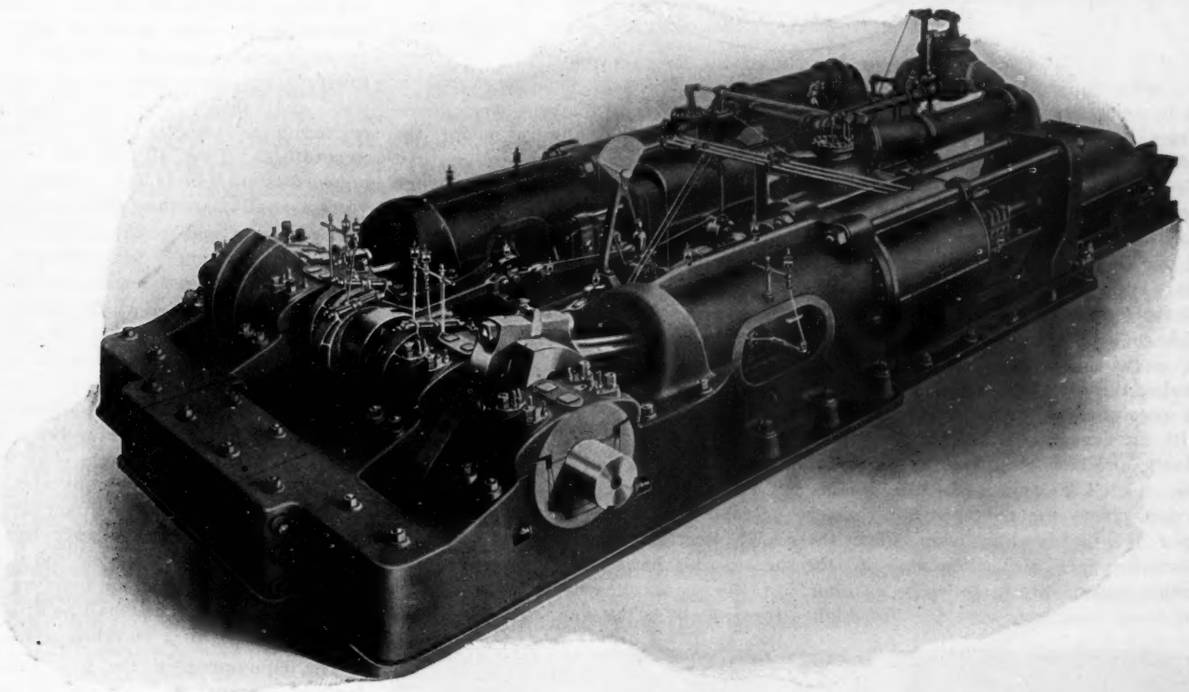
(Showing total power to be generated by low-pressure turbo electric plant.)

| | | |
|---|---|---|
| Small blast-furnace: | | |
| From exhaust steam | 1,920 | horsepower |
| Bessemer steel works: | | |
| From exhaust steam | 2,868 | " |
| Total | 4,788 | horsepower |

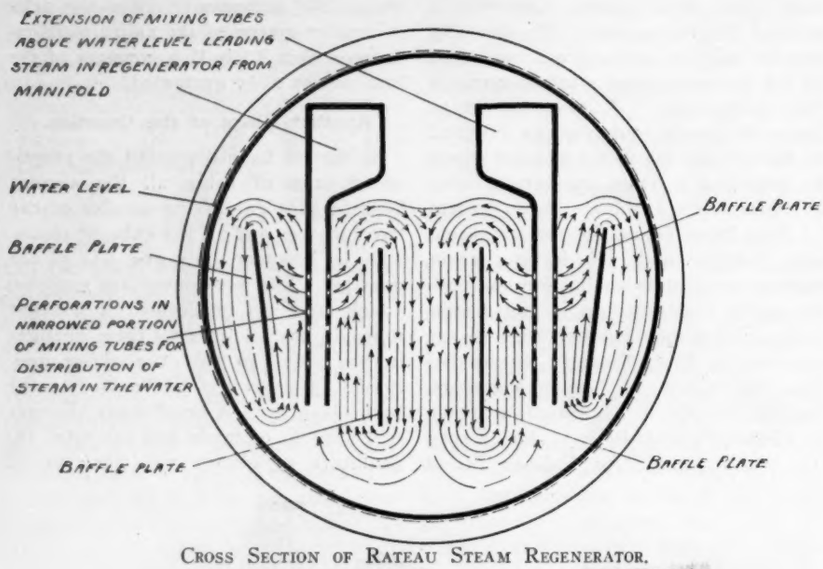
### Another Phase of the Question.

So far we have discussed the proposition only of using all the surplus blast-furnace gas of the smaller of the two furnaces and all the exhaust steam. This is, however, only one side of the question. The most important question which must yet be decided is whether it would pay to make all these changes in the plant so that the above-mentioned by-product could be used to the best advantage. A great many changes will have to be made and the total expenditure of money will have to be large before any profits can be made. And the only way by which reasonably certain estimates of the possible saving can be attained will be to put in the form of a balance sheet all outlays, expenses and profits.

Now the total saving possible will evidently be that due to the low-pressure turbine installations. Against this saving must be charged the operating cost of the low-pressure turbine station. The profits resulting from this installation will be the difference of cost between the engine power displaced and the cost of the same power generated in low-pressure turbines and converted into electrical energy. No value is assigned to the exhaust steam because without the turbine it has no value in a metallurgical works. The machinery in this metallurgical works



32 INCH AND 56 INCH x 50 INCH TWIN COMPOUND REVERSING ENGINE; MESTA MACHINE CO.


EXTENSION OF MIXING TUBES ABOVE WATER LEVEL LEADING STEAM IN REGENERATOR FROM MANIFOLD
WATER LEVEL
BAFFLE PLATE
PERFORATIONS IN NARROWED PORTION OF MIXING TUBES FOR DISTRIBUTION OF STEAM IN THE WATER
BAFFLE PLATE
BAFFLE PLATE
BAFFLE PLATE

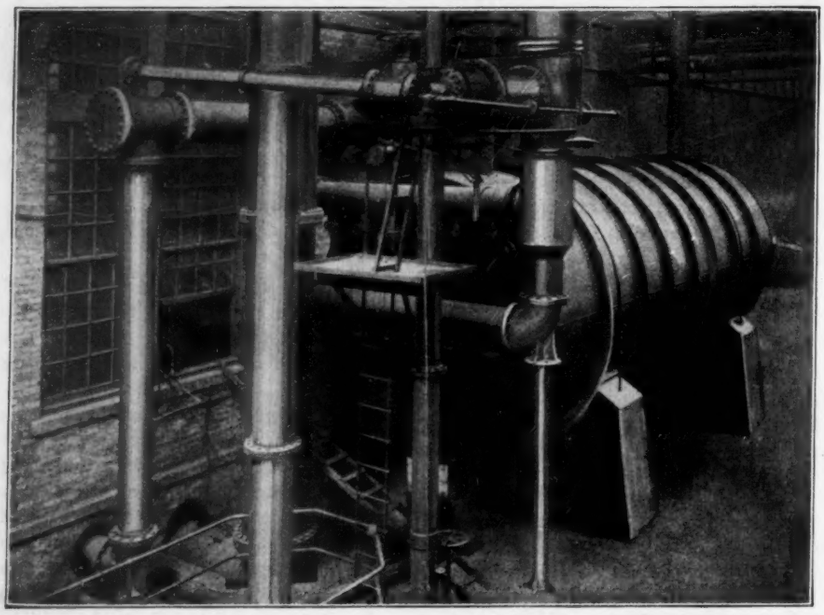
CROSS SECTION OF RATEAU STEAM REGENERATOR.

is in operation on an average 7,200 hours per year. All engines considered herein are single expansion. The loads on these engines vary between wide limits, often from the friction load of the different machines to 15 per cent overload. It is easy to see that under conditions like these the cost per horsepower per year must be high. There is perhaps no metallurgical works in peration in this country having the old style power plants such as were constructed years ago that can, with the exception of the furnace power plants, produce a horsepower hour at less than 1.25 cent. In the furnace power plants the cost per horsepower hour is considerably lower since the costs for fuel and attendance in the boiler houses are practically nothing. In many cases the cost will no doubt be higher than 1.25 cent per horsepower hour. This figure is for the total of fixed and operating charges. From data and conditions with which the writer is familiar in other metallurgical works he judges that the cost per horsepower hour in the metallurgical works for which this low-presure turbine installation is worked out can under no consideration be less than that given.

### What is Necessary to Make the Low-Pressure Turbo-Installation Possible.

The total power which is to be developed in the low-pressure turbines is 4,788 electrical horsepower. In order to use this power in the different parts of the works it will be necessary to transmit it to the different motors and if we take 12 per cent for the average loss in transmission and in the motors, we will have a total of 4,200 horsepower available at the motor shafts.

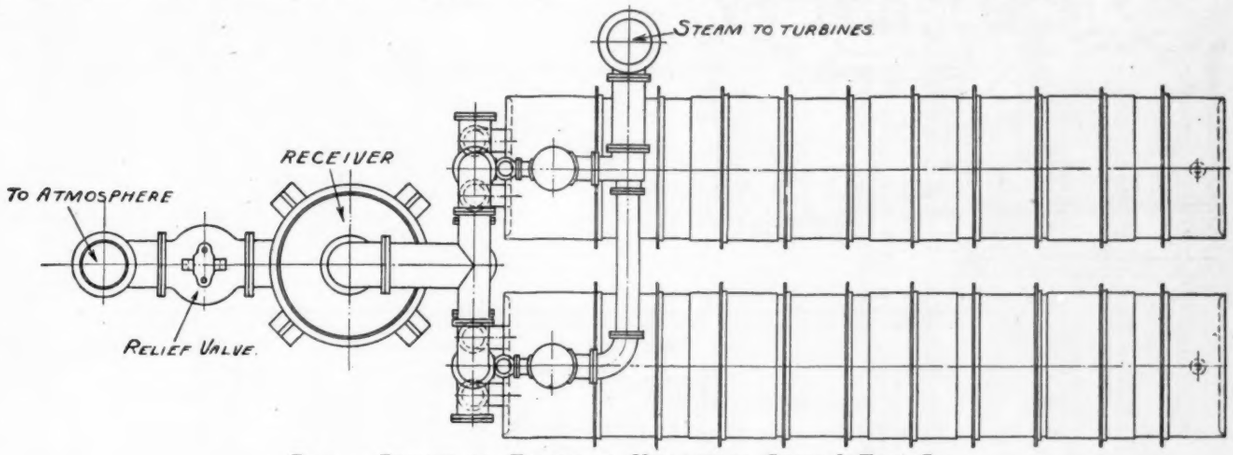
In order to realize the saving possible with the low-pressure turbine installation it will be necessary to find a use for the 4,200 horsepower. It is therefore proposed to use same in the manner given below. The power developed in the low-pressure turbines shall be converted into electrical energy. The generating station shall be located between the small furnace plant and the steel works. These two last mentioned departments of this plant are so located that one low-pressure turbine station could be made to use both the exhaust steam from the steel works and also from the small furnace. The engine using the steam generated with the surplus furnace gas shall be located in the low-pressure turbo-generating station also and shall drive an alternator operating in parallel with the turbo generators. Two 250 K. W. rotary converters shall be installed which converters shall take the 2,000 volt alternating current and transform it into 220 volt direct current. Some direct current will be required for the auxiliaries of the turbo station which auxiliaries shall be motor driven, also for driving crane motors and miscellaneous small motors scattered through the works and for lighting the offices, shops, and other departments of the works. The 250 K. W. rotary converters shall have common busses and each converter will be able to carry the entire direct current load. In this manner an accident to one rotary will not paralyze the direct current machinery. The building for this generating station shall be of brick and be fitted with a traveling crane.



RATEAU STEAM REGENERATOR AT WORKS OF INTERNATIONAL HARVESTER CO., CHICAGO, ILL.

The equipment of the low-pressure turbine station shall consist of three 1,600 K. W. low-pressure turbo alternating current generators of 2,000 volt pressure. There shall further be located at this station a 200 K. W. alternator driven by the steam engine mentioned and operating in parallel with the low-pressure turbine machinery. As mentioned before the engine receives the steam generated with the surplus furnace-gas. There shall likewise be installed at this station two 250 K. W. rotary converters; the details and purposes of this installation shall be as given before. Ordinarily one of these rotaries will be sufficient to furnish all the direct current needed. The reserve capacity of this station will be 50 per cent. Two condensers shall be installed, each with sufficient capacity to serve the entire station. The reserve capacity of the condensing plant would therefore be 100 per cent. This large reserve capacity in the condensing plant is considered necessary because the turbines

would become practically useless if one condenser had to be shut down for some reason and if no other were available to take its place. The cost of the low-pressure turbo station would be as shown in Table III.




PLAN OF REGENERATOR EQUIPMENT, YOUNGSTOWN SHEET & TUBE CO.
(Courtesy of Rateau Steam Regenerator Co.)

TABLE III.

| | |
|---|---|
| Piping | 25,000 |
| Building | $ 30,000 |
| Foundations | 12,000 |
| Three low-pressure turbines with electric generators, steam regenerators, station wiring and complete electrical equipment, including switchboard, exciters, rotary converters | 158,000 |
| Two condensers, including pumps, piping, etc. | 23,000 |
| Traveling crane | 8,000 |
| Total | $256,000 |

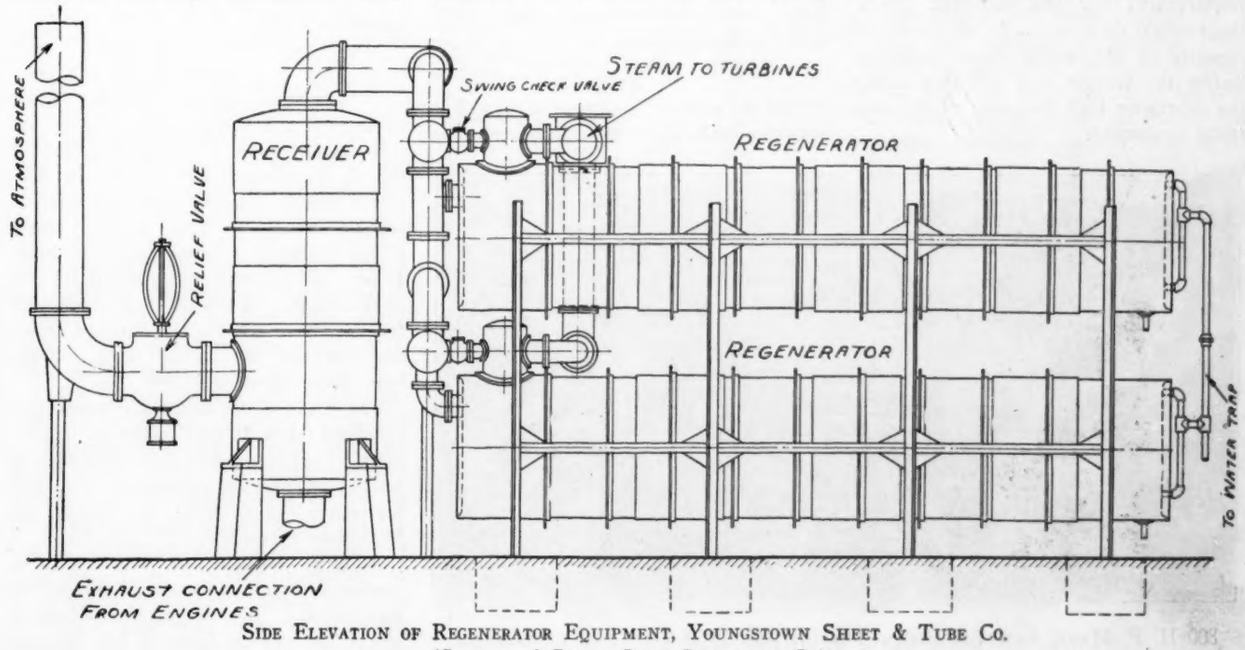
### Motor Installations in the Mills.

The total electrical energy available at the motors in the different departments will be 4,200 horsepower. The engines located in the departments that will be equipped with electric drives shall be replaced with electric motors. The amounts to be expended for this equipment have been estimated liberally because in many cases it will be more difficult to install the motor drives by reason of the fact that the original drives were planned as engine drives. It is also found that in all metallurgical works the motor capacity exceeds greatly the generating station load. This is especially found to be the case in a department where many small motors are operating intermittently and where the loads on the individual motors vary between wide limits. For this reason in one department which has many small motors operating intermittently the motor capacity has been chosen 100 per cent larger than the loads on these motors.

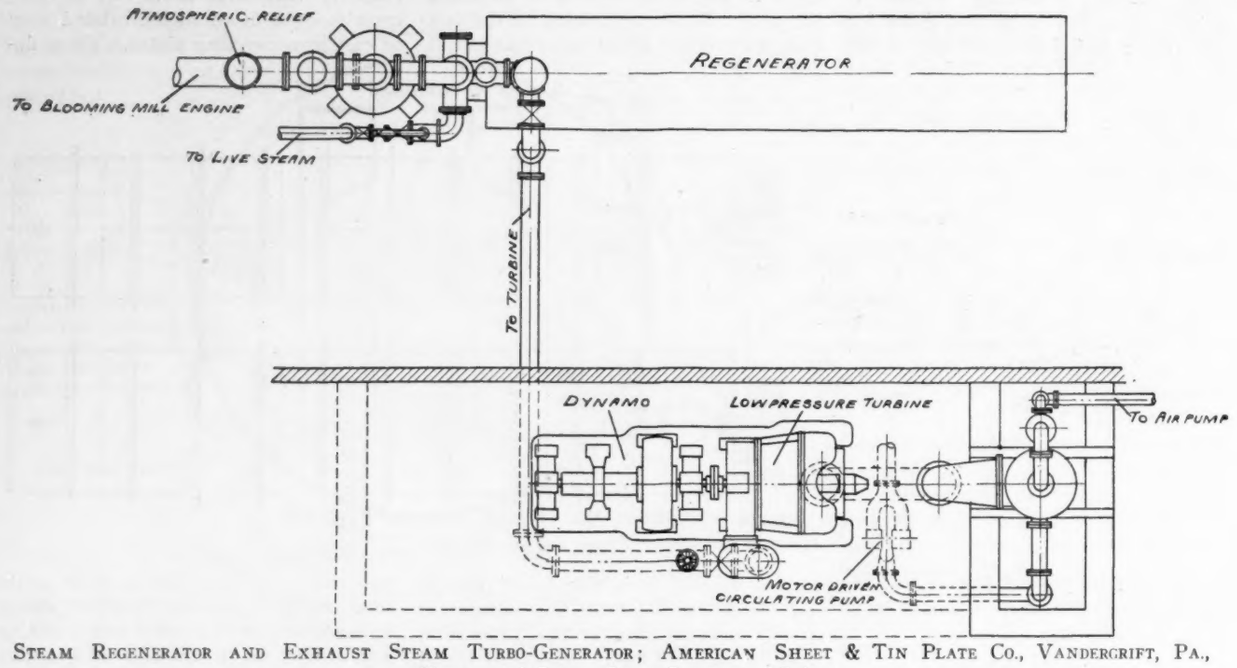
In the rolling mill department are five mill engines to be replaced by motors each of 500 horsepower normal capacity. These motors shall be connected through gears to the mill driving spindles on which is mounted a heavy flywheel. They shall use alternating current at 2,000 volts. On account of the high voltage no overhead cables are to be used. All such cables, properly insulated, shall run in concrete troughs fitted with insulated steel or cast iron covering plates. These details must be attended to with great care and it is essential that everything be made secure in a place like a rolling mill where many laborers and others not familiar with the requirements of high voltage conductors pass them many times a day. The small motors driving the mill tables shall receive 220 volts direct current from the rotary. The mill driving motors shall be built with 100 per cent overload capacity as customary in such motors. The cost of this installation complete, ready for operation has been taken at $56,000.

### Motors for Department "T."

As stated before the average load in Department "T" is much less than the rated capacity of the motors. This average load is 1,200 horse power. The motor capacity of this division of the works is 2,400 horse power. To anyone not familiar with the conditions in a




SIDE ELEVATION OF REGENERATOR EQUIPMENT, YOUNGSTOWN SHEET & TUBE CO.
(Courtesy of Rateau Steam Regenerator Co.)




STEAM REGENERATOR AND EXHAUST STEAM TURBO-GENERATOR; AMERICAN SHEET & TIN PLATE CO., VANDERGRIFT, PA.,
(Courtesy of Rateau Steam Regenerator Co.)

metallurgical works this capacity may seem unnecessarily high; but it must be remembered that the nature of the work is such that some motors such as shear, hoist, crane, etc., are idle for a large part of the time. In several such works of which the writer knows the ratio of average load on the station to rated motor capacity is as 1:4. This, however, does seem high and no doubt in many cases machines could be so combined and arranged as to bring the above ratio down to 1:2 or at least to a ratio not greater than 1:3. Then, too, in many cases the motors are chosen much larger than is actually necessary. Careful tests of the power requirement for the different operations might do much to bring the motor capacity of the works down somewhat nearer the average load and thus reduce the otherwise high first cost of the electrical equipment.

In the Department "T" of the works the motors used are in sizes of from two to sixty horse power and for this reason no high-voltage alternating current shall be used. Since a rotary converter will have to be installed in order to reduce the high pressure alternating current to direct current, it is proposed to install same in a small building adjoining this department which will thus form a substation to the main turbine generating station and in this manner reduce the cost of copper for the transmission conductors. The cost of installing these motor drives will be as shown in Table IV.

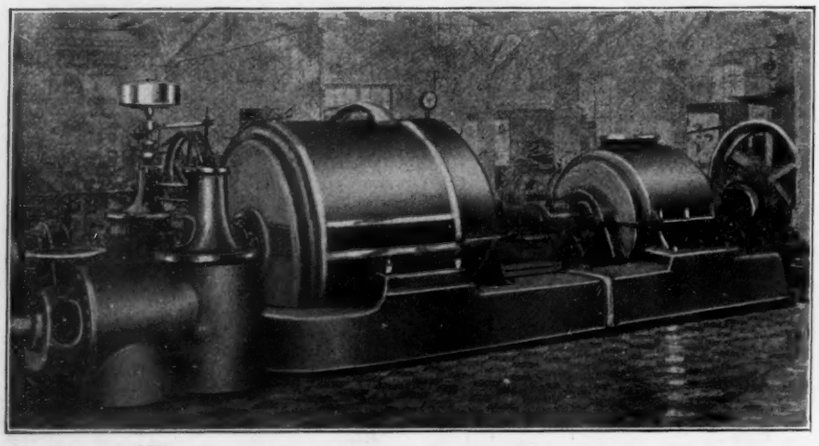
TABLE IV..

| | |
|---|---|
| Sub-station building | $ 3,000 |
| Rotary with necessary cables, switchboard, etc. | 18,000 |
| Motor installation, wiring, etc. | 36,000 |
| Total | $ 57,000 |

For the sake of clearness a resumé is given in Table V of the total expenditures necessary in order to make an advantageous use of the 4,200 horse power generated in the low-pressure turbines.

TABLE V.

| | |
|---|---|
| Low-pressure generating station complete as given in Table III | $256,000 |
| Motor installations in rolling mills | 56,000 |
| Motor installation in department "T" | 57,000 |
| Total | $369,000 |



800 H. P. MANN EXHAUST STEAM TURBINE AND 1,050 VOLT A. C. GENERATOR.

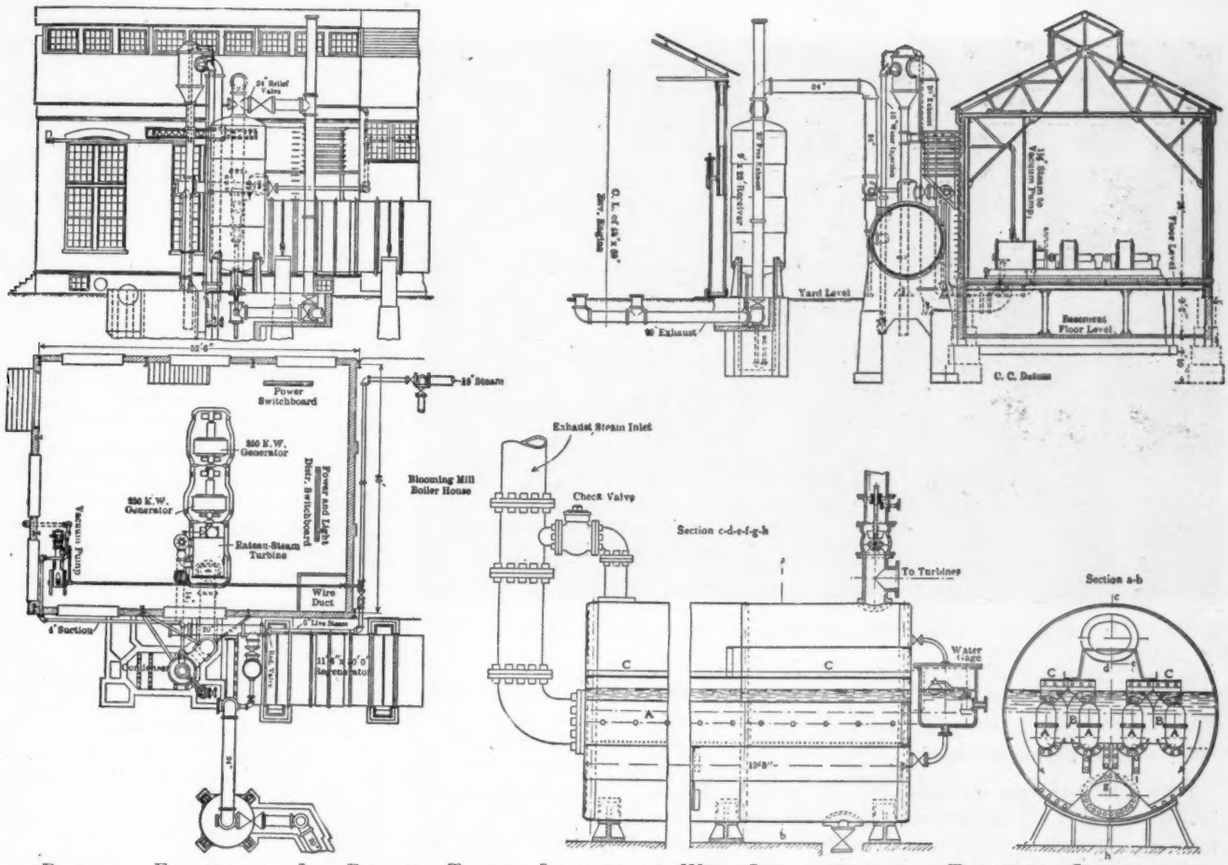
### Annual Cost of Operation.

The total cost of power generated is made up of the fixed charges and the operating costs. The interest on the investment, the depreciation and maintenance expenses of the equipment, taxes and insurance constitute the fixed charges. The cost of lubricants, water, repairs, wages and salaries make up the operating costs.

The fixed charges of the entire equipment have been taken at 15 per cent. This may seem high at first but in the opinion of the writer it is best to set this amount aside for this item because the electrical machinery in metallurgical works usually has to give hard service and the motors are often put into dusty places where the temperature is high. 12 per cent is sometimes allowed for the fixed charges in such installations but for the above reasons this amount seems too low and the annual fixed charges have been taken at 55,400.

The cost for oil, waste and lubrication has been taken at 0.006 cents per K. W. hour. This is considerably more than is usually allowed for this item. The total lubrication cost will accordingly be $1,812 per annum.

A large quantity of water will be needed for the condensers of this power installation. As in all metallurgical works the one in question has its own




PLAN AND ELEVATION OF LOW-PRESSURE TURBINE INSTALLATION WITH LONGITUDIN AL AND TRANSVERSE SECTIONS OF REGENERATOR.

pumping plant and the cost of pumping and delivering the water through the mains is low. The cost of water has been figured as 1.25 cent per 1,000 gallons The cost of the 10,000,000 gallons of water needed per 24 hours for the condensing plant is taken at $125 per day or $37,500 per annum.

For the proper attendance of the generating station there would be required per turn, one first engineer at 30 cents per hour, one second engineer at 25 cents per hour, one helper at 22.5 cents per hour, to be used wherever needed and one dynamo and switchboard man at 22.5 cents per hour. For the proper operation of the large mill motors in the rolling mills there will further be required five men per turn at 22.5 cents per hour, and perhaps three men per turn at the same wages to look after the small motors in department "T". The total outlay for wages inclusive of superintendence would therefore be $24,000.

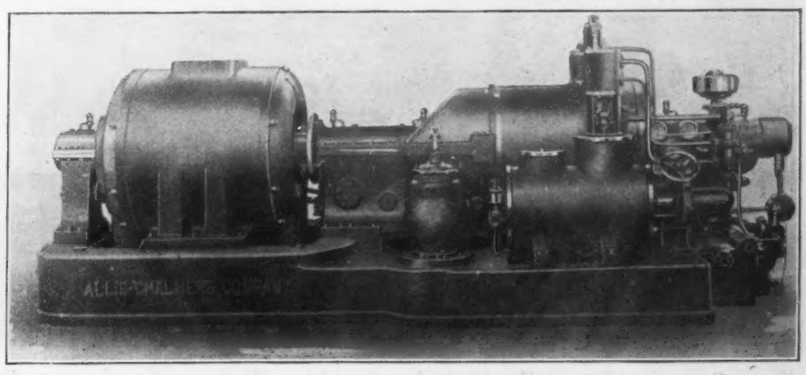
Under maintenance small repairs are included in the fixed charges. In order, however, to make provision for heavy repairs which cannot be included under maintenance and which may be due to wear or accidents, it is deemed best to set aside a fund for the occurrence of such conditions. In the operation of large turbo generators it has been found that after they have been in operation four or five years it is usually necessary to rewind the generators and while the machines of this installation are not of such very large dimensions it might be well in order to be prepared for emergencies to set aside a fund for possible repairs of a similar nature. It has been figured that .02 cent per horse power hour would cover all emergencies; on this basis the annual fund to be set aside for repairs would be $6,050.

Table VI following, shows the annual cost of operation, itemized and in total.

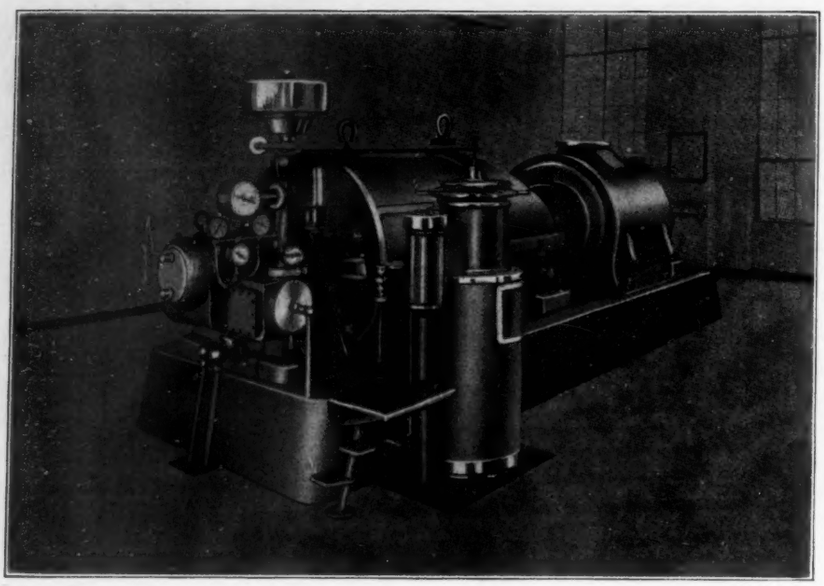
TABLE VI.

| | |
|---|---|
| Fixed charges | $ 55,400 |
| Lubrication | 1,812 |
| Water | 37,500 |
| Wages and salaries | 24,000 |
| Repairs | 6,050 |
| Total | $124,762 |

We have now our figures in such shape that we can draw our final deductions from same. It will be conceded after a careful examination by all those familiar with actual conditions in metallurgical works that the estimates of the cost of equipment and also the operating costs as given herein have been taken sufficiently high. The writer knows of a case where the operating expenses including fixed charges of a similar but smaller low-pressure turbo installation operating with a load factor of 51 per cent were found to be only 0.3 cent per K. W. hour. In the present case the operating expenses come to 0.4 cent per K. W. hour with a much larger generating station and with a practically constant load factor of over 90 per cent.



ALLIS CHALMERS EXHAUST STEAM TURBO-GENERATOR.



900 K. W. Exhaust Steam Turbine, Zollverein Mine.

It is therefore believed that the allowance is liberal.

### The Saving Effected.

Table VII shows the saving which will be realized if 4,200 horsepower of the present equipment were displaced with motors receiving their current from the low-pressure turbo generating station.

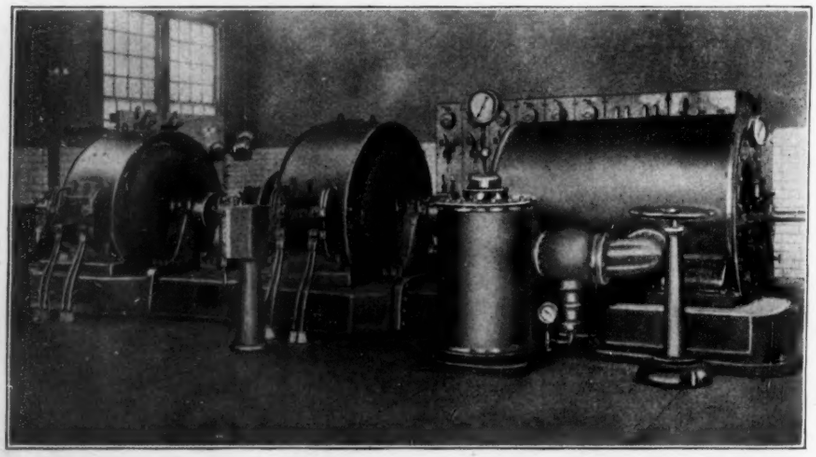
TABLE VII.

| | |
|---|---|
| Present cost of 4,200 horsepower per annum | $378,000 |
| Fixed charges and all operating expenses for same power generated in low-pressure turbo generating station and used in motors | 124,762 |
| Net saving | $253,238 |
| Return on investment | 68.55% |

The saving of 68.55 per cent is a large one. The profit would, however, be even larger because the steam machinery displaced is not useless but would have a market value and the buildings vacated by the steam equipment would also have a value. Assuming that the original price for the steam equipment was $45 per horse power and assuming further that one-fourth only of this amount could now be realized for this equipment, the 4,200 horse power would represent an item of $47,250. In the final accounting the new installation would have to receive credit for this amount and to this extent its first cost would be lessened. This lessening of the first cost would decrease the fixed charges and thus diminish the operating expenses, which in turn would have a tendency to increase the net profit.

One other point which might be brought against the proposition of installing the low-pressure turbo generating station, together with the motor drives, is the high expenditure necessary before any profit can be realized. The writer does not consider this an argument against the proposition because of the large net profit resulting from the installation. Furthermore, any commercial enterprise with products of say between $5,000,000 and $6,000,000 annually can not seriously hesitate at an expenditure of $369,000 for new equipment which by displacing the old will make possible profit of 40 per cent, unless a way can be pointed out which will make still greater profits possible for the same expenditure of money; we will refer to this point later. Of course if the general arrangement of a metallurgical works had become so antiquated as to make the operation of all its departments unprofitable, a change in the power department as outlined here could not help the situation much; in such a case an entire rebuilding would be the only solution and in that event propositions similar to the one here discussed would deserve serious consideration.

Another favorable feature and one of considerable importance and no doubt fully realized and appreciated by all metallurgical men, is the fact that the operation of the works need not be interfered with at all while the change from the old power to the new is being made. The necessary work could be so planned that all departments could continue operations. No doubt the importance of this will also be realized by those not familiar with plants of this kind when it is stated that a delay of 24 hours means a decrease in output to the value of from $20,000 to $25,000 or more. The entire equipment in the turbo generating station could be put into place and it would only be necessary to shut down those departments that are to furnish the exhaust steam long enough to make the proper connections.



Turbo-Generator Set at Works of International Harvester Co., Chicago, Ill.

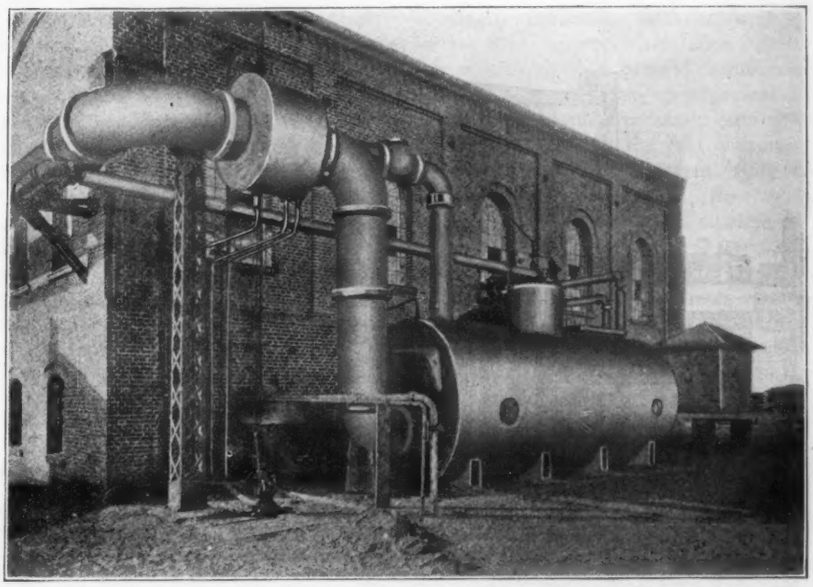
### Low-pressure Turbo Generation vs. Gas-Electric.

It might be urged by the friends of the gas engine that if the power is to be generated most economically why not install gas engine equipment? The argument may be advanced that since a horse power hour can be obtained with gas engine equipment on 12,000 B. t. u. even under unfavorable conditions, that therefore it would be more economical. The only way to avoid guesses is to reduce this matter to concrete figures.

In the works under consideration 45 pounds is the average steam consumption for all the engines and pumps displaced by motor power, the current for which is generated in the low-pressure turbo station. Reduced to the engine-turbo combination we would get a horse power hour on 19 pounds of steam for the generation of which would be required $1,100 \times 19 \div 0.60$ or 34,900 B. t. u. This would give a ratio of economy of 1 : 2.9 in favor of the gas-engine. The boiler efficiency has been taken in this case as 60 per cent which is perhaps a little more than is realized the entire year.

The total gas production per hour in the manufacture of 700 gross tons of iron at the plant in question would be 700×150,000÷24 or 4,380.000 cubic feet. After deducting from this figure the proper quantities of gas, viz., that needed for gas blowing engines used to blow the furnaces, for the stoves, for waste and leakage, for the miscellaneous other power purposes around the furnace, there will remain about 50 per cent of the total gas available for outside use or 2,190,000 cubic feet per hour. This quantity used in gas engines would develop 2,190,000×90÷12,000 or 16,400 horse power.

Now one of the furnaces has a capacity of 400 gross tons and the other a capacity of 300 gross tons per 24 hours; therefore the reliable supply of gas cannot be taken at more than 90 per cent of that generated in the smaller furnace. As stated several times before it is absolutely necessary that reliable operation be assured and this makes it essential that at least 10 per cent less than amount generated in the smaller furnace be taken as the reliable quantity of gas available at all times. It is for the sake of reliability that only 90 per cent of the total gas of the smaller furnace is taken because it may happen that the large furnace is shut down for repairs or for some other reason and that the small furnace is not operating properly. The reliable supply of gas is therefore 300×150,000×0.90÷24 or 1,690-000 cubic feet and in a gas-engine electric central station 50 per cent of this quantity would give about 6,000 horse power at the motors. Since the power required for the furnace is already deducted from the above 6,000 horse power, the 90 per cent of the total available gas from the smaller of the two blast-furnaces would be sufficient for operating the entire plant with gas-electric machinery, provided the capacity of the smaller furnace is 300 gross tons per 24 hours as stated. If, however, the capacity of this smaller furnace were only 200 gross tons per 24 hours, the gas-electric central station could not be considered at all because the available surplus furnace gas would not generate all the required power in gas engines even. Further, if the smaller furnace is of 300 gross tons capacity it would still be hazardous to depend solely on gas-electric power for the entire works with two furnaces only, for it must be kept in mind that one furnace may be off for re-lining or other extensive repairs which might take months to complete and in such an event the supply of power would depend on the furnace in operation. It is evident in such a case that the furnace in operation would have to be handled with the greatest care; even then it is almost certain that the gas engine plant, and with it the entire works, would come to a standstill at times because it would be found impossible to furnish at all times a continuous flow of gas. However, with great care and watchfulness it might be possible to reduce to a very small number of interruptions to operation of the works by reason of shortage in gas and with a few inconveniences and perhaps a reduced tonnage at intervals the works might be kept in operation until the furnace undergoing repairs was in service again.



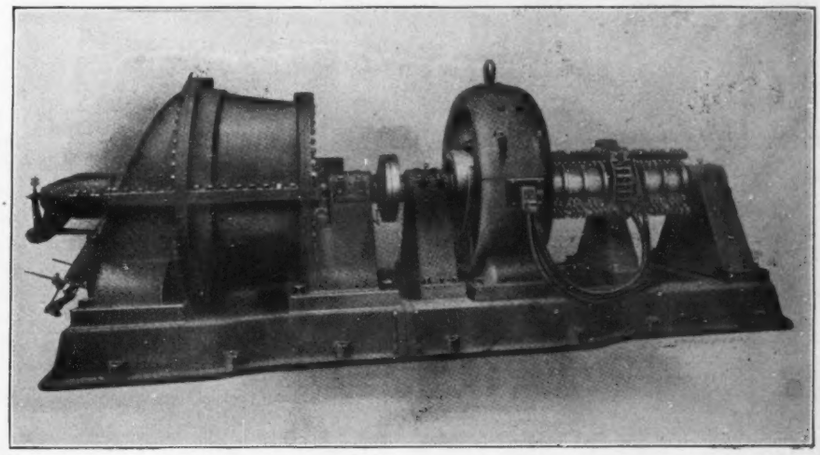
RATEAU STEAM REGENERATOR FOR TURBO-COMPRESSOR; CONCORDIA MINE, OBERHAUSER.

**Total Costs of Gas-Electric Equipment.**

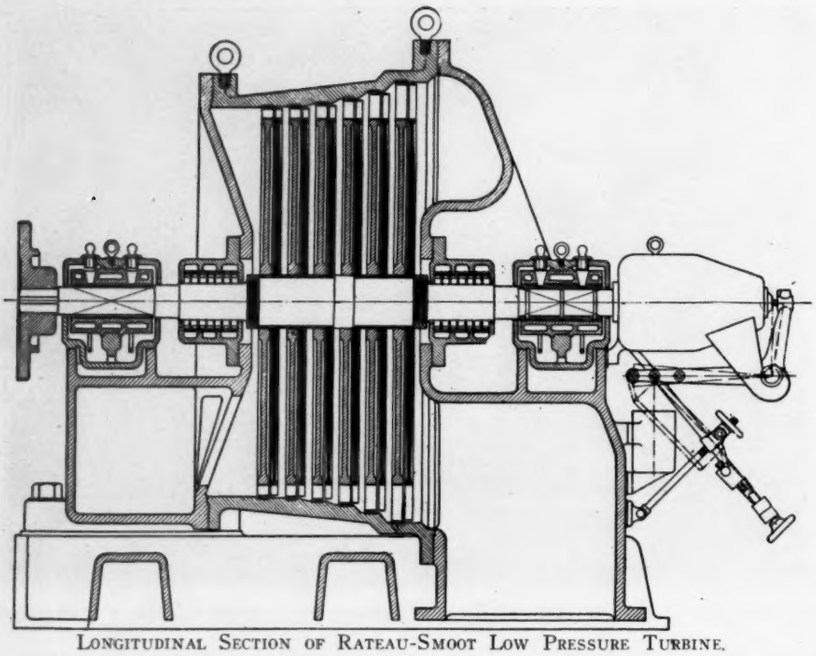
In order to get a clear idea of the relative savings resulting from the engine-turbo-electric and gas-electric installations it is necessary to determine the fixed charges and the operating expenses for the latter in the same manner in which it has been determined for the former.

If we are to depend on a reliable supply of gas-electric power at all times with two blast-furnaces, separated by a distance of a half a mile, it becomes necessary either to have one gas cleaning plant at each furnace and therefore two in all, or as an alternative, one centrally located gas cleaning plant half way between the two furnaces. In the case under consideration the cheapest proposition will be to construct one centrally located gas cleaning plant with gas-electric central station near by and by means of large ducts to lead the gas from each of the furnaces to this cleaning station and from here the gas can be taken to the gas-electric station. The quantity of gas required for the gas blowing engines would also have to be taken back to the furnaces in ducts of proper size.

In considering the gas-electric station, the furnaces would have to be given gas blowing engines, the surplus gas would have to be converted into electrical energy by means of gas engines and electric generators and all steam drives in the mills and in other places in the works would have to be replaced with



RATEAU-SMOOT LOW-PRESSURE TURBO-GENERATOR.
(Courtesy of Ball & Wood Co.)



LONGITUDINAL SECTION OF RATEAU-SMOOT LOW PRESSURE TURBINE.
(Courtesy of Ball & Wood Co.)

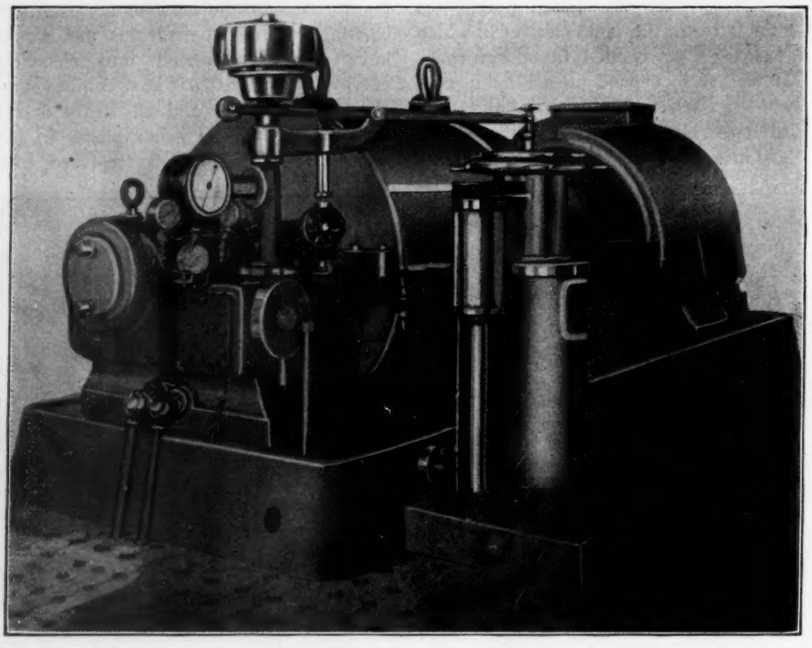
electric motors. The gas-electric generating station, as also the gas cleaning plant, would be modern in their designs and would be so planned as to combine simplicity with economical and reliable operation. Some time since the writer worked out and published a careful estimate for two metallurgical works that were to pool their gas-electric output of power and since to his knowledge his plan was not criticized, nor his figures for that estimate contradicted, he takes the liberty of using those figures as a basis in the present comparisons.* The cost of the gas-electric installation would be as given in Table VIII.

*Iron Trade Review, January 7, 1909.

TABLE VIII.

| | |
|---|---|
| Cost of the gas electric equipment for the two furnaces | $491,000 |
| Cost of gas electric central station | 512 000 |
| Cost of gas cleaning equipment | 110,000 |
| Cost of electric motor equipment | 292,000 |
| Total | $1,405,000 |

In the paper already referred to the fixed charges of the gas-engine electric equipment were taken at 14 per cent. This is no doubt a little low and 15 per cent should perhaps be set aside for this purpose. Table IX gives the estimated cost of operating this gas-electric equipment. The writer's figures published some time ago and referred to herein several times have been taken as a basis.



750 K. W. EXHAUST STEAM TURBINE, HELENE AND AMALIE MINE, BERGEBORBECK.

TABLE IX.

| | |
|---|---|
| Fixed charges | $210,000 |
| Water | 19,750 |
| Lubricants | 38,000 |
| Salaries and wages | 50,000 |
| Repairs | 19,000 |
| Total | $337,250 |

**Cost of Power for Entire Works With Turbo-Electric Equipment.**

It is necessary to put the engine-turbo-electric combination and the gas-electric installation for the entire plant on a common basis in order to compare them intelligently. This is necessary because we could not compare the low-pressure-turbo installation of 4,200 horse power with a gas-electric installation of 9,750 horse power. The only reasonable method which we can use in the present case is to see to what extent the 4,200 horse power generated in the low-pressure turbines will reduce the entire power cost of the present steam equipment. Then, after all operating expenses and fixed charges for the gas-engine electric installation have been considered for the same plant and after we know the cost of power with the old equipment, we can proceed to a comparison.

The total horse power required at this work is 9,750; 4,200 horse power is to be generated with the low-pressure turbines; about 3,700 horse power is required for the furnace power plants and about 1,850 horse power for the steel works and miscellaneous purposes.

We found previously that the annual cost of generating the 4,200 horse power with the low-pressure turbo equipment is $124,762. The cost per horsepower in the furnace power plants will be the cost of operating, with coal as fuel, similar equipment in other power plants, other conditions being the same, minus the saving due to the absence of those expenses occurring in connection with coal fired boiler plants. If we take the cost per horse power year at $60 in a plant where coal-fired boilers are used and where large, single expansion non-condensing engines operate under practically steady loads and where steam coal costs $1.50 per gross ton, we believe that we have estimated the cost of power for such equipment correctly. The total cost of the 3,700 horse power for the two furnace plants would therefore be $222-000. If we further take a feed-water temperature of 200 degrees Fahr., a steam pressure of 110 pounds gage, an average steam consumption per horse power of 35 pounds, an average boiler efficiency of 60 per cent, 14,000 B. t. u. per pound of coal and the price of coal, fired and ashes removed at $2.00 per gross ton, the absence of the coal bill and the other expenses connected therewith would be

the equivalent of a saving of [35×(1187—200)×3,700×7,200×2]÷(0.60×14,000×2-240) or $98,000. The 3,700 horse power would therefore cost per annum $222-000 minus $98,000 or $124,000.

We have further to generate with steam equipment 1,850 horse power for the steel works blowing engines, for the hydraulic pumps and the blooming mill engine. The load on the latter machine is of an intermittent character and as usual in all such work the load varies between wide limits. We have taken the complete cost per horse power hour in this department at 1.25 cent. The power cost per annum would therefore be 1,850 ×1.25×7,200 or $166,500. The total power cost for the entire plant would be per annum as given in Table X.

TABLE X.

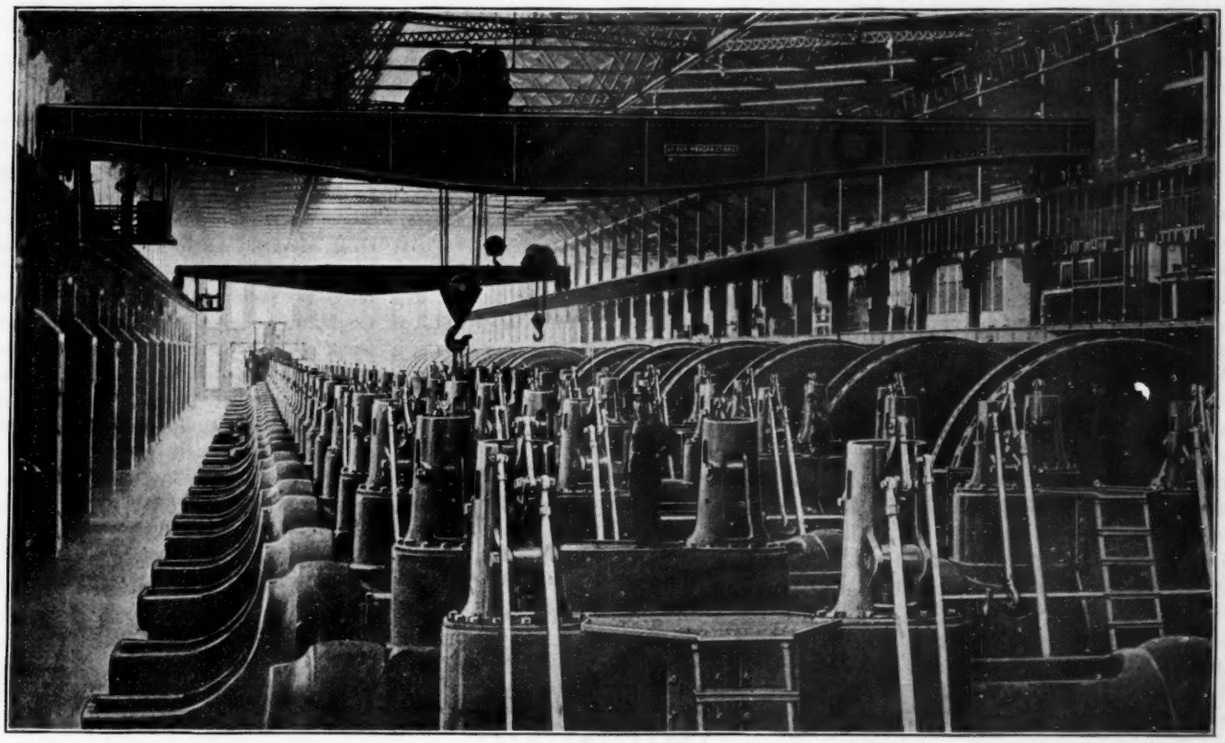
| | |
|---|---|
| 4,200 horsepower low-pressure turbo-electric plant | $124 762 |
| 8,700 horsepower furnace power plants | 124,000 |
| 1,850 horsepower steel works and blooming mill | 166,500 |
| 9,750 horsepower | $415,262 |

### Cost of Same Power With Present Steam Equipment.

In order both to make our comparison complete and to show the actual saving resulting from each of the two installations discussed when compared with the present existing steam equipment, it becomes necessary to determine the total power cost of the present steam equipment. For the furnace power plants, the steel works and the blooming mill the power costs have already been determined. The remaining 4,200 horse power is used in the rolling mills and in department "T", in which latter department are used about 1,500 horse power in old time slide valve engines ranging from two to one hundred horse power. The total cost for power in these departments including fixed charges cannot be taken at less than 1.25 cent per horse power hour and at this rate the annual costs would be $378,000. Table XI gives a resumé of the present steam power costs.

TABLE XI

| | |
|---|---|
| Furnace power plants | $124,000 |
| Steel works and blooming mill | 166,000 |
| Rolling mill and department "T" | 378,000 |
| Total | $668,000 |



PARTIAL VIEW IN POWER HOUSE OF INDIANA STEEL CO., GARY, IND. SEVENTEEN 2,500 K. W. ALLIS-CHALMERS GAS-ELECTRIC UNITS.

### Power Cost Comparison.

We have now determined the cost of the 9,750 horse power per annum for the old steam engine installation, for the mixed installation resulting when as much low-pressure turbo electric power is used as is possible in connection with some of the old steam equipment, and further, for an equivalent gas-electric installation in which blast-furnace gas is used as fuel. All these plans and estimates are worked out for the same plant and as a matter of course the conditions assumed for all three systems had to be the same. These figures, it must be remembered have in them nothing of the absolute. By this the writer means that for other plants the differences in cost of power for the systems discussed herein will not always be in exactly the same ratio as worked for the plant under consideration. It is only possible to draw general conclusions from the estimates and data presented. While it is possible to work out with considerable accuracy the fuel consumption ratios for the different systems of generating power, yet the total cost depends upon a great number of items that have no relation whatever to the fuel. The size of the plant, the conditions of the existing steam equipment, the ratio of the low-pressure turbo electric power to steam power, the general lay-out of the plant and that of the different departments of same, etc., are all factors of vital influence on the cost of power generated by the different systems.

In this discussion no value has been assigned to the exhaust steam because in the everyday running of the works it is wasted and therefore it has no value. The same is practically true of the blast-furnace gas; in the ordinary running of the works practically all the blast-furnace gas is used in the stoves and for generating steam for the furnace plant. If now a reliable new power is furnished to the furnace plant which enables it to carry on its operation as before and if the generation of this new power is more economical than the old method, it is by no means clear that the new system should be charged for something which under the old method had no value. In Table XII, following, is

given a resume of the cost of generating power for the plant under discussion by the methods proposed.

TABLE XII.

(Showing cost of 9,750 horsepower generated by the three different systems discussed.)

| | |
|---|---|
| Estimated annual cost of power with present steam equipment | $668,500.00 |
| Average cost per horsepower, year.. | 68.25 |
| Estimated annual cost of power with as much steam machinery displaced by low-pressure turbo electric equipment as is practihcal | 436,112.00 |
| Average cost per horsepower, year... | 44.75 |
| Estimated annual cost of power with gas-electric equipment | 337,250.00 |
| Average cost per horsepower, year... | 34.50 |

### Conclusions.

When the nature of the equipment is considered, anyone familiar with steam machinery operating intermittently and under fluctuating loads will readily concede that $68.50 per horse power year is a conservative figure. In the plant under discussion a reduction of 35 per cent of this cost can be effected by installing 4,200 horse power in low-pressure turbo electric equipment. This last mentioned equipment is planned in such a way as to make it absolutely reliable in operation by reason of its 50 per cent reserve capacity. The expenditure necessary in order to attain this saving would not be exessive if the magnitude of the change is considered. In less than two years the equipment would have paid for itself and after that time the annual saving in the entire power plant of the works would be $232,000. This is a saving which more than justifies the original expenditure.

The gas-electric installation would furnish the cheapest power for the plant and with good management and both furnaces running there would be no trouble experienced in its proper operation. The saving of $331,000 per annum is a large one, but the original expenditure also would be large. If the installation of this gas-electric equipment were undertaken the new installation would pay for itself in about four years.

The capital necessary, however, would be considered large when the size of the plant is considered. It might also be reasoned that if the power plant in a works is in such condition as to make its annual operating expenses very high there are no doubt also other departments which need rebuilding or which might be enlarged profitably. And if the amount which is necessary to spend for a gas-electric plant were used in rebuilding some of the deficient operating departments it might be quite possible to increase the tonnage of the works to such an extent as to make far greater profits possible than the most economical power plant would yield. To illustrate:

One million dollars of the $1,400,000 necessary to place in operation the gas electric equipment would build one modern 400-ton blast-furnace plant complete. The remaining $400,000 would be sufficient to enlarge the blowing capacity of the Bessemer works, build larger vessels, purchase a larger blooming mill engine and in general enlarge the steel works to such an extent that all the pig iron made in the new furnace could be converted, say, into a semi-finished product, as billets for instance. Such a change might easily be made because the main lay-out of the plant would remain as it is. If we take the figures furnished by the Bureau of Corporations as a basis and assume a net profit of $4 per ton in the production of pig iron and $4 per ton in the production of billets, profits which should be more than possible with current prices, the expenditure of the $1,400,000 would make an annual net profit possible of at least $850,000. Under such conditions it is really seen that it would be a good business policy to continue with the old but serviceable steam equipment in operation and use the $1,400,000 for enlarging the tonnage capacity of the works. This is perhaps one reason why we find old and uneconommical power equipment in many metal metallurgical plants.

We have already spoken of the possibility of one blast-furnace being out of blast. While with great care it might be possible to keep in operation the gas-electric equipment with only one furnace in blast, it is not all likely that this could be done without serious interruptions at times and this would be another reason why the proposition of a gas-electric installation would not be received with much enthusiasm in any existing works with two blast-furnaces only. Such gas engine installations would of course become much more feasible if two or more plants would work together, act in unison and pool their gas-electric power output. However, this too, would bring in its train peculiar difficulties of its own. For all these reasons, in the smaller metallurgical works the low-pressure turbo electric power plant in connection with some existing steam equipment deserves much more serious consideration than it has received in the past.

# THE PRESENT POSITION OF ELECTRIC STEEL REFINING

## The Latest Developments in Electric Furnace Working in Europe and America

By John B. C. Kershaw.

The article upon "The Problems of Waste Heat Utilization in Iron Works," which appeared in The Iron Trade Review for Feb. 18, 1909, included some particulars relating to the progress of the electric furnace methods of steel refining. The boards of management and presidents of American iron and steel works were urged to apply the power now wasted in their blast-furnace gases, to the production of structural and rail steel in the electric furnace,—and examples were given from European practice showing how this method of working was both practical and economical. It is the writer's purpose in the present article to amplify the information contained in the article referred to, and to give the latest available details relating to the progress of electric furnace methods of steel production.

As regards the number of furnaces in operation the list on page 77 gives the latest information regarding the installation of the four leading types of furnace.

Taking the totals previously given for the Stessano furnaces, we have the following revised list:

| | | | Kgs. |
|---|---|---|---|
| 1 | Heroult furnace | 19 | 63,000 |
| 2 | Girod | 16 | 60,000 |
| 3 | Rochling Rodenhauser | 10 | 29,200 |
| 4 | Kjellin | 14 | 25,200 |
| 5 | Stessano | 11 | 16,900 |

Which gives a total of 70 furnaces in operation or nearly completed, with an aggregate charge capacity of 194,300 kgs. or 2,800 kgs. per furnace charge.

Since there are between 10 and 15 furnaces of other types than those named above in operation in Europe and America, the writer estimates the number of steel refining furnaces in operation or nearly completed at the close of 1909 to be 80. Taking the

average charge of these furnaces to be 3 tons, and the number of charges per day to be two, the daily output of electric steel at the close of 1909 must amount to 480 tons. This is a small total when compared with the enormous daily output of the steel works in America, but it is large enough to prove that the electric steel furnace has emerged from its period of experimental trial, and that it has now become a permanent and useful accessory of the modern steel plant.

Dr. Engelhardt, a director of the Gesellschaft für Electrostahl Analagen, which controls the Kjellin and Rochling-Rodenhauser patents and developments in central Europe, in a paper read before the chemical section of the Austrian Society of Engineers in Vienna on April 23, 1909, gives the graphical summary shown in Fig. 1, page 78, of the position in the electrical steel industry in March of last year.

These figures were undoubtedly too low, as regards the Heroult and Girod furnace capacity, and the totals given by the writer in the present article, represent the position today much more fairly, the opening of the Girod steel works at Ugine having greatly altered the relative position of this furnace and process.

Engelhardt in the same paper gives a useful tabular statement of the approximate power required per ton of finished material for the various processes of smelting and refining which can be carried out in the electric furnace, the figures being based on the average figures obtained with large units. This statement is reproduced below:

| | | Kilowatt hours. |
|---|---|---|
| 1 | Maintaining pig iron in the molten state for casting purposes | 50 |
| 2 | Refining molten metal from the open-hearth furnace | 120 to 250 |
| 3 | Steel from molten pig iron and cold scrap | 600 |
| 4 | Steel from cold pig iron and cold scrap | 700 |
| 5 | Steel from cold scrap | 900 |
| 6 | Steel from molten pig iron | 1,100 |
| 7 | Steel from cold pig iron | 1,500 |
| 8 | Pig iron direct from the ore | 2,000 |
| 9 | Steel direct from the ore | 3,000 |

The price of electrical energy is the deciding factor in determining which of the various uses of the electric furnace can be profitably carried on in the particular district concerned.

As regards the size of the individual furnaces, the largest Heroult furnace in operation, is that of the Aceries du Saut du Tarn at St. Juery, France, this having a capacity of 5,000 kgs. (five tons) per charge, while a furnace of equal capacity is stated to be at work at the Halcomb Steel Co.'s works at Syracuse, N. Y. The Societa Tubi Mannesmann at their works at Dalmine in Italy, have completed however, two 6,000 kg. furnaces. It will be of some interest to note whether the Heroult type of crucible furnace can be successfully worked in these larger units, most of the refining so far having been carried out in furnaces of three tons capacity. The chief difficulty with the Heroult furnace is, the regulation of the current during the melting of the charge, when both arc and resistance heating are employed, great variations in the resistance of the charge occurring during this stage of the heating process. As the size of the furnace increases and larger currents are employed, this difficulty is likely to become intensified, and on this account a limit to the practical capacity of the furnace is certain to be found. The other special difficulty found in the operation of the Heroult furnace, namely, the over-heating and consumption of the carbon electrodes, has been overcome by the use of water-cooled stuffing boxes for these, packed with a special conducting mixture of graphite and carbon grains, which enables a large surface of the electrode to be employed for electrical connection to the cables conveying the current. Having studied completely the problem of manufacturing the higher classes of motor-car and tool-steel, Heroult is now turning his attention to the production of structural and rail steel in his furnace, and in a letter to the writer, dated Jan. 13, 1909, he stated that he was working at this branch of the subject with some hope of success.

The largest Stassano furnaces are to be found at the works of the "Forne Termo-elletrici Stassano" at Turin, Italy, where two 5,000 kg. furnaces of this type have been erected. In the case of the Stassano furnace, the heat effect is obtained entirely by radiation from two or more arcs formed *above the charge*, and the difficulties connected with the regulation of the current, met with in the operation of the Heroult furnace, do not occur. On the other hand the electrical efficiency is lower, the most reliable figures showing a power consumption of 1,164 kilowatt hours per 2,000 pounds of steel, as compared with 864 kilowatt hours for the Heroult type of furnace.

The "Bonner Fraserfabrik" at Bonn, have erected and are working, two 1,000 kg. Stassano furnaces, and the Italian government have two 700 kg. furnaces, at the Royal Arsenal, Turin.

As regards the Kjellin induction type of furnace, the largest in operation is that at the Krupp works at Essen, this furnace being of 8,500 kgs. capacity.

A furnace of similar size, until quite

HEROULT FURNACES.

| | | In operation. Kgs. | Under construction. Kgs. |
|---|---|---|---|
| Richard Lindenburg, Germany | 3 | 5,300 | ..... |
| Bismarkhutte, Germany | 2 | 4,000 | ..... |
| Deutsch - Oesterreichische Mannesnonn - Rohren Werke, Burbeck | 1 | ..... | 3,000 |
| Danner & Co., Austria | 1 | 2,000 | ..... |
| Gebr. Bohler & Cie, Austria | 1 | 2,500 | ..... |
| Georg. Fischer, Switzerland | 3 | 1,000 | 10,000 |
| Soc. Electromet, Francaise Savoy | 1 | 3,000 | ..... |
| Acieries du Sacet du Tarn, France | 1 | 5,000 | ..... |
| Aktiebolaget Heroults Elektriska, Stal Sweden | 1 | 4,500 | ..... |
| Halcomb & Co., N. Y., U. S. A. | 1 | 5,000 | ..... |
| Firth Stirling Steel Co., U. S. A. | 1 | 3,000 | ..... |
| Soc. Tubi Mannesmann, Italy | 2 | ..... | 12,000 |
| Edgar Allen & Co., England | 1 | ..... | 3,000 |
| Totals | 19 | 35,300 | 28,000 |

GIROD FURNACES.

| | |
|---|---|
| S. A. E., Procedes Paul Girod, Ugine, France | 4 |
| Oehler Co., Aarau, Switzerland | 1 |
| Cockerill & Co., Seraing, Belgium | 1 |
| Stotz & Co., Stuttgart, Germany | 1 |
| Marrel Freres, Rive de Gier, France | 1 |
| Danner & Co., Judenburg, Austria | 1 |
| Gutehoffnungshutte, Oberhausen, Germany. | 1 |
| Stahlwerk Becker, Crefeld, Germany | 3 |
| Poldihutte, Alt-Kladno, Austria | 1 |
| Ternitzer Stahlwerk, Ternitz, Austria | 1 |
| Diosgyr Stahlwerk, Diosgyr, Hungary | 1 |
| Total | 16 |

ROCHLING RODENHAUSER FURNACES.

| | | In operation. Kgs. | Under construction. Kgs. |
|---|---|---|---|
| GERMANY: | | | |
| Rochlingsche Eisen und Stahl Worke, Volklingen | 2 | 7 000 | ..... |
| | | 2,000 | ..... |
| Bergische Stahl - industrie, Remsheid | 1 | 1,500 | ..... |
| Le Gallais Metz & Co., Dommeldingen | 4 | 3,500 | ..... |
| | | 3,500 | 1,500 |
| | | 700 | ..... |
| FRANCE: | | | |
| Acieries de la Marine et d'Homecourt, St. Chamond | 1 | ..... | 3,000 |
| BELGIUM: | | | |
| Acieries Liegesoises Bressouxles-Liege | 1 | 1,000 | ..... |
| RUSSIA: | | | |
| Kronwerke Slatoust | 1 | 2,000 | ..... |
| Totals | 10 | 24,700 | 4,500 |

KJELLIN FURNACES.

| | | In operation. Kgs. | Under construction. Kgs. |
|---|---|---|---|
| GERMANY: | | | |
| Fr. Krupp A. G. Essen | 1 | 8,500 | ..... |
| Oberschles, Eisen-Ind, A. G. Gleiwitz | 1 | 1,500 | ..... |
| AUSTRIA: | | | |
| Poldihutte, in Kladno | 1 | 4 000 | ..... |
| J. Braun's Sohne Vocklabruck | 1 | 400 | ..... |
| GREAT BRITAIN: | | | |
| Vickers Son & Maxim, Sheffield | 2 | 1,500 | 180 |
| Wm. Jessop & Sons, Sheffield | 1 | ..... | 1,800 |
| Sheffield University | 1 | 100 | ..... |
| ITALY: | | | |
| Alti Forni Gregorini Lovere | 1 | ..... | 1,500 |
| SPAIN: | | | |
| Vidua de Urigoitia e Hija, Araya | 1 | 1,500 | ..... |
| SWEDEN: | | | |
| Eisenwerk Domnarfort Cysinge | 1 | 1,500 | ..... |
| Sybry Searls Ltd., Trollhauttan | 1 | 2 000 | ..... |
| UNITED STATES: | | | |
| General Electric Co., Schenectady | 1 | 60 | ..... |
| General Electric Co., Niagara Falls | 1 | 750 | ..... |
| Totals | 14 | 21,810 | 3,480 |

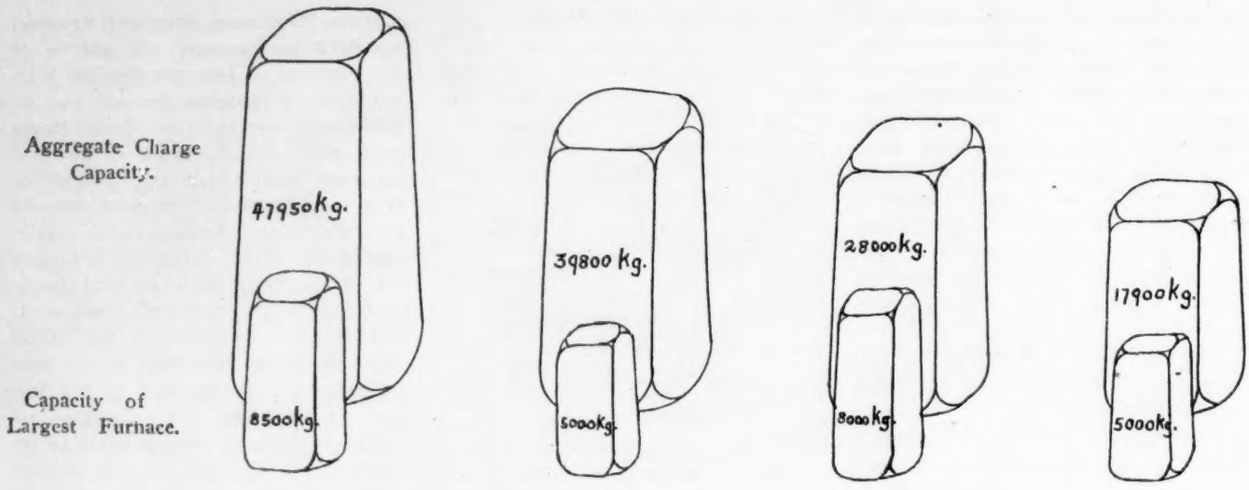



FIG. 1.

recently was in operation at the Rochling Iron & Steel Works, at Volkingen; but this has now been converted into the modified Rochling-Rodenhauser type of furnace, and the remaining Kjellin furnaces are of 4,000 kgs. 2,000 kgs. and 1,500 kgs. capacity. Owing to the inability of the original Kjellin type of furnace to attain a high temperature, it can only be used as a melting furnace, and on this account its field of usefulness is limited.

Coming now to the Rochling-Rodenhauser furnace, the type which is at present attracting most attention, it may be explained that this furnace utilizes a combination of induction and resistance methods of heating, and that by this combination the difficulties due to the low temperature of the metal and slag in the original Kjellin type of furnace are overcome. The experimental work connected with the development of this furnace was carried out at the Rochlingsche Iron & Steel Works at Volkingen, by Dr. Rodenhauser and Dr. Schonawa.

There are now two furnaces of the new type in operation at Volkingen, one of these utilizing three-phase current in place of the more usual single-phase current. The tabulated statement gives the localities of the other furnaces. The largest furnace of this type is the 7,000 kg. furnace now in operation at Volkingen.

According to Engelhardt the United States Steel Corporation have under construction a furnace of this type which is to be of 15,000 kgs. capacity, capable of heating a full converter charge at each refining operation. This furnace will work with single-phase current of normal U. S. A. periodicity: 25. As already stated, the Rochling-Rodenhauser furnace can be modified to use three-phase current of almost any range of periodicity, and it can be thus worked when necessary or desirable without the intermediate transformer equipment required by the arc types of furnace. As three-phase current is usually employed for the operations of electric rolling mill and other steel work plants, this adaptability is of some importance. Figs. 2 and 3 show a plan and section of this latest form of induction furnace.

No detailed figures for the power consumption of these large furnaces have been given, but Harden in a recent paper, read before the Faraday Society, stated that when using molten metal from the converter for charging the furnace, the power varied from 125 to 150 kilowatt hours per ton of finished material. The corresponding figure for the Heroult furnace is 329 kilowatt hours per ton of 2,000 pounds. No doubt, under exactly similar conditions as regards the purification effected in the furnace, the power consumption of these two types of furnace would be more nearly equal.

Finally, as regards the Girod type of furnace the largest yet constructed is a furnace of 12,000 kgs. capacity, at the new electric steel works, at Ugine in Savoie. Details of this works and furnace have already appeared in THE IRON TRADE REVIEW of June 3, Oct. 28, and Dec. 9, 1909, and it is therefore unnecessary to deal at length with these here. This steel works is the first operated entirely with electric power and its future will be followed with much interest by electrometallurgists on both sides of the Atlantic. Professor Borchers of Aachen, who has visited the Ugine works more than once during 1909, has been very favorably impressed by the simplicity of working and economy of the Girod type of furnace, and now considers it superior to the Heroult furnace and the best type of arc furnace yet designed.

No attempt has been made by the writer to compare the working efficiencies of the various types of furnaces named, or the quality of steel produced, since these branches of the subject of electric steel refining are outside the

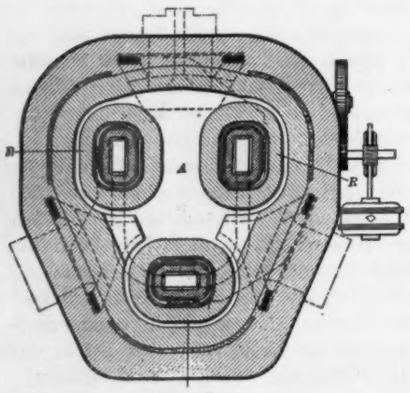


FIG. 2.

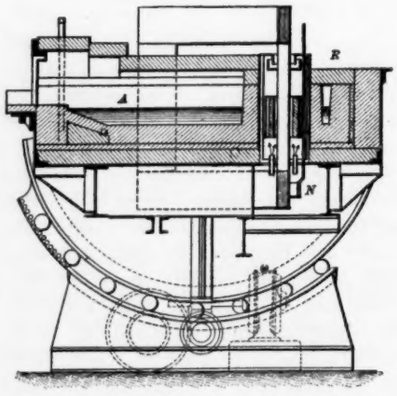


FIG. 3.

scope of the present article. It is certain, however, that the earlier published figures for current and power consumption will be reduced as more experience is gained in the design and working of these furnaces, and that for the production of high quality steels they will become indespensable.

The writer is also convinced that in a few years time, every steel works will be forced to erect one or more of these furnaces as adjuncts to its present plant. The works whose managers have had the courage and foresight to erect a plant for utilizing the waste energy of the coke oven and blast furnace gases, will certainly gain by this new development. The cost of the electric energy in their case will be represented merely by the interest on capital, and upkeep of the new plant and the experience gained by the Cockerill Co., at Seraing, in Belgium, proves this to be extremely low.

# VANCOUVER'S NEW STEEL FOUNDRY

## "The Only Steel Foundry West of the Great Lakes."

The demand for steel castings in the western part of Canada has kept pace with the rapid development of that section. Machinery used in the lumber and mining industries must be constructed to withstand very heavy work. Steel castings, which enter largely into the manufacture of this class of machinery, had to be shipped from the eastern part of Canada or imported from the United States or England and this was expensive because of high freight rates and long deliveries.

Realizing the growing need of such a plant in that portion of the Dominion, the directors of the Vancouver Engineering Works, Ltd., early in 1909, decided to add a steel foundry to their plant at Vancouver, British Columbia. The side blow converter for making steel was adopted, after careful consideration of the most economical process for producing a light tonnage, and after personal inspection of various plants by F. L. Leighton, general manager.

In May, 1909, the Whiting Foundry Equipment Co., Harvey, Ill., was commissioned to design and equip the steel foundry according to the most up-to-date practice. Erection of the plant was commenced in June, and the equipment installed during the following September. The first blow of steel was successfully made Oct. 12, under the supervision of the Whiting Foundry Equipment Co.'s steel foundry engineer.

The plant has at present a capacity of eight tons per day, and is so designed that extensions for handling double that output can be made as required, without interrupting the operation of the present foundry. The building is of steel construction throughout, having a main bay 120 feet long, and 50 feet wide, with a side bay 120 feet long, and 30 feet wide, as shown on the ground plan, Fig. 1. The side bay is designed to provide the most compact grouping of the melting and converting department, the core room, sand mill, and cleaning department, without in any way interfering with the economical operation of each. In the design, every effort was made to secure a continuous system, that the raw material might be converted into finished castings without any reverse movement. The steel foundry is so arranged in the plotting of the general plant, that the movement of all departments is in the direction of the castings store house.

The cupola is the standard Whiting type having a rated capacity of six to seven tons, and the height from floor level to top of stack is 35 feet. In order to properly charge the converter, the melting capacity is about seven tons per hour. The cupola charging floor is 22 feet long and 20 feet wide, and is served by a 2-ton electric elevator, having a lift of 16 feet. In order to facilitate the handling of melting stock, an industrial track, 24-inch gauge, connects the elevator with the stock yard.

Iron is tapped from the cupola into a 6,000-pound ladle, carried by a pneumatic jib crane of 4 tons capacity, as shown in Fig. 2. Two taps are made to obtain a full charge for the converter. This is done to avoid holding the molten iron in the hearth of the cupola where it is exposed to the incandescent coke from which it will absorb sulphur, especially if the manganese content is low. After the ladle is filled, the jib crane hoists it to the pouring position, shown in Fig. 3, and the iron is transferred to the converter, to be blown into steel.

Since no phosphorus or sulphur can be removed, owing to the acid lining of the converter, it is necessary to melt an iron running low in these elements, the maximum limit being 0.04 per cent for each. The manganese content ranges from 0.60 per cent to 1.50 per cent. The cupola charge is so proportioned as to give about one per cent of manganese, this limit being set because it counteracts the affinity of the iron for the sulphur in the coke, and also minimizes the wear upon the converter lining. The percentage of silicon in the cupola charge should be from 1.80 per cent to 2.00 per cent.

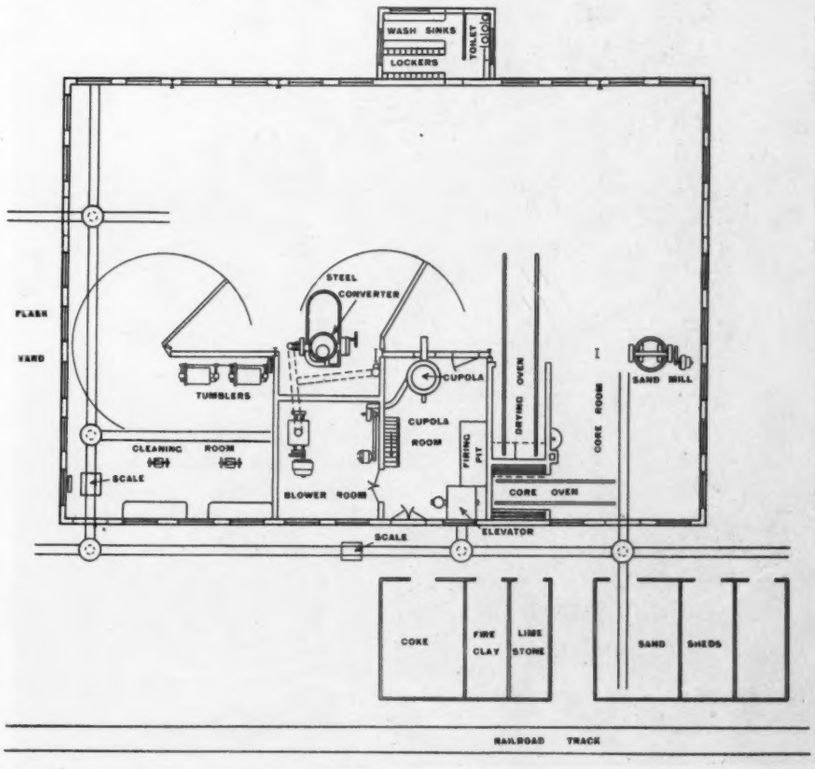



FIG. 1—GROUND PLAN OF STEEL FOUNDRY, VANCOUVER ENGINEERING WORKS.

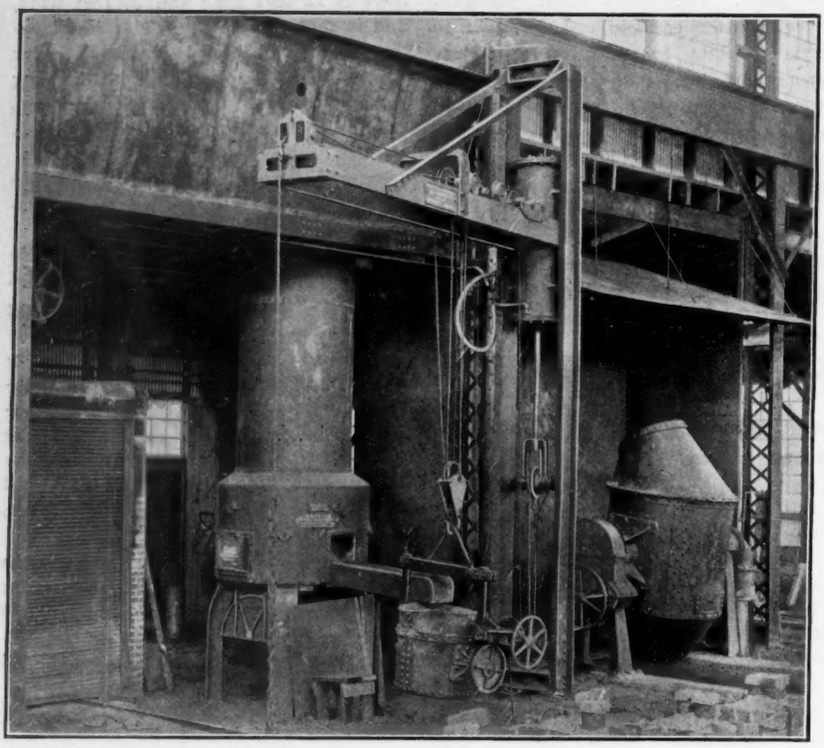


FIG. 2.

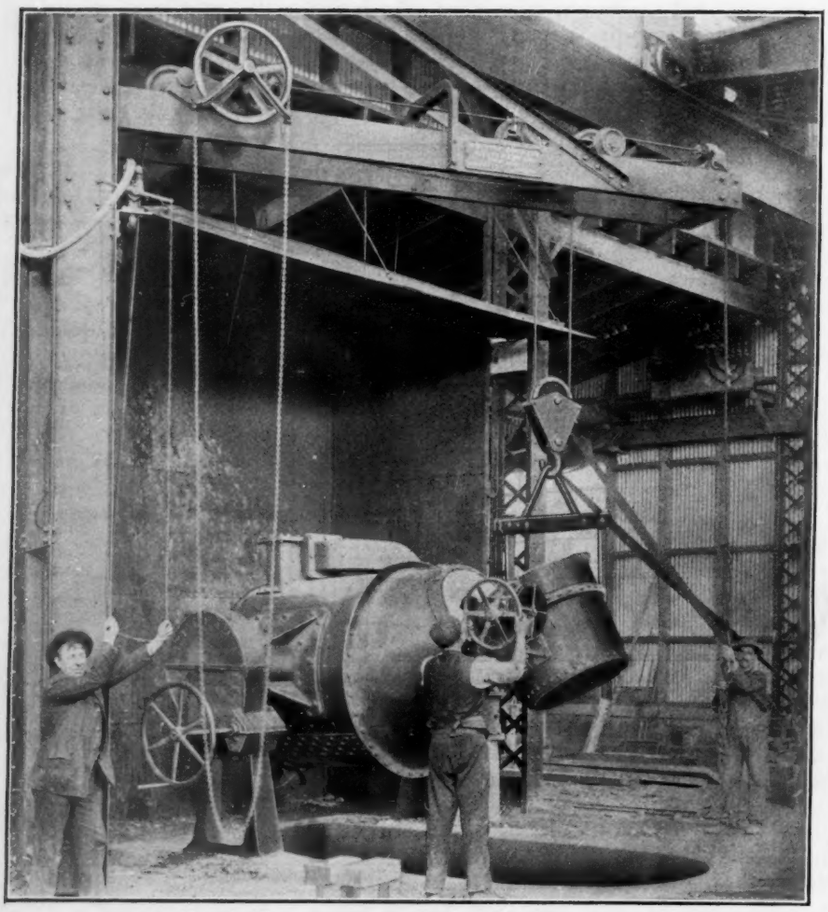


FIG. 3.

The extensive manufacture of boilers, tanks, etc., gives this concern a heavy stock of punchings and clippings to draw upon for the cupola charge. In order to produce steel castings of high grade, careful attention is given the sulphur and phosphorus limitations.

The converter, having a capacity of two tons, is of the standard Whiting type. It occupies a floor space 20 x 12 feet, and is separated from the remainder of the side bay by a steel curtain wall. It is carried on cast steel trunnions, which revolve in heavy cast iron standards, and spans a concrete pit into which the ladle is lowered to receive the finished steel, as shown in Fig. 4. A large hood is suspended above the converter, to carry the fumes outside the building. The height of the converter is 10 feet, when in blowing position. It is lined with a composition of ganister, sand and fire clay, rammed around a wood form. This linings, if repaired when necessary, will give at least 180 or 200 blows.

After the iron is poured into the converter, the latter is then turned to an upright position for blowing. The air pressure ranges from three to five pounds per square inch, and is regulated by a valve at the operator's platform. The blowing operation requires from 15 to 20 minutes, varying with the percentage of metalloids in the iron. It is necessary that the time be as brief as possible, as upon the rapidity of the blow depends the temperature of the bath. Fig. 5 shows the converter during the progress of the blow. The reduction in the weight of metal is about 18 per cent. The steel comes from the converter at 1700 degrees Cent., a temperature insuring sufficient fluidity to yield sharp, sound castings of light section.

Back of the converter, and on a level with the foundry floor, is the blower room, which is equipped with a positive pressure blower for the converter, and a steel pressure blower for the cupola. The positive pressure blower, built by the P. H. & F. M. Roots Co., Connersville, Ind., is belt connected to a 75-horsepower Allis-Chalmers-Bullock alternating current motor. The steel pressure blower, built by the B. F. Sturtevant Co., Hyde Park, Mass., is belted to a 10-horsepower Allis-Chalmers-Bullock alternating current motor.

The blast main to the converter is in a straight line to insure the minimum loss due to friction. A 14-inch blast pipe connects the cupola with the blower. Regulation of the blast for the cupola is accomplished by means of a standard blast gate.

The core room, core oven and mold

drying oven are in the side bay, adjoining the cupola room, and cover an area 40 feet long and 30 feet wide. The mold drying oven, which holds two cars, is 18 feet long and 10 feet wide, and is fitted with a Kinnear roller-curtain door. The core oven is 10 feet square, equipped with side shelves for cores, and has a swinging steel plate door. Coal is used for fuel. Adjoining the core room, is the sand mill room, with a 72-inch mill, built by the Vancouver Engineering Works, Ltd. This mill is of the undergeared type, and is belt driven by a 25-horsepower Allis-Chalmers-Bullock alternating current motor. A pneumatic sand shaker, built by the Hanna Engineering Co., Chicago, is located between the sand mill and core room.

The cleaning room adjoins the blower room, and opens into the main bay. The equipment consists of a cold saw and two power hack saws, built by the Quincy-Manchester-Sargent Co. Two emery grinders, built by the Diamond Machine Co., provide ample facility for grinding the present output of the foundry. Provision has been made for the future installation of an annealing furnace.

The Vancouver Engineering Works, Ltd., manufacture an extensive line of logging and saw-mill machinery, all types of boilers, burners for saw-mills, and mining machinery.

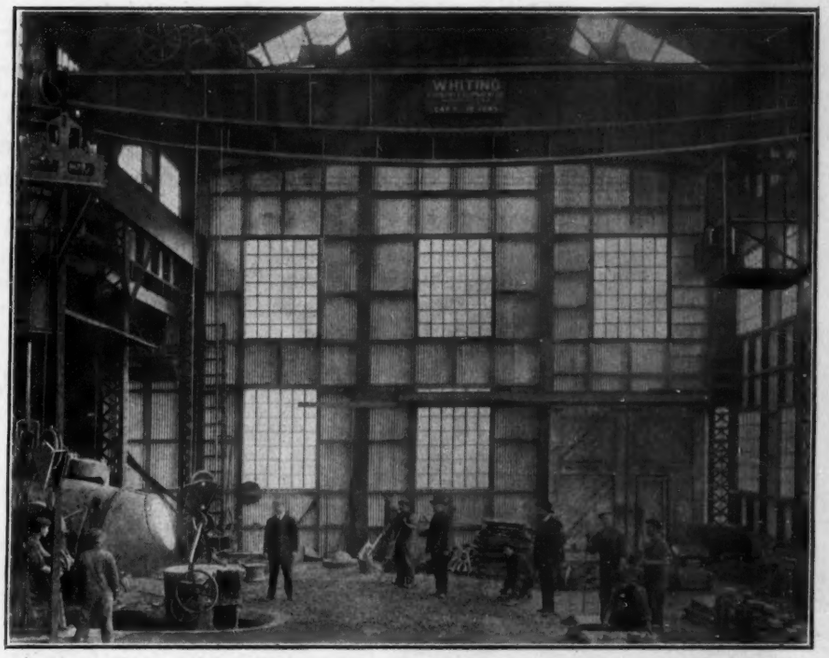


FIG. 4.

## "VOLUNTEERS" IN MACHINE SHOPS.

BY DR. ROBERT GRIMSHAW.

I would like to call attention to one prominent feature of German and English — and as far as I know, French—machine shops; the so-called "volunteer" system.

It is well understood that where a young lad starts to learn his trade he can do so on either one of two bases —either as an apprentice proper, or as a "volunteer," who may quit at any time desired. The former method involves both duties and privileges; the latter carries with it, once entered upon, privileges only. In the first case, there may or may not be a slight pay attached to the position; in the second, the almost universal custom is that the volunteer shall, for the trouble he gives the firm and its employes, pay a specified fee in advance—for instance in the shops of Ludwig Loewe & Co., Berlin-Schoeberg, the fee is 1,000 marks ($238) the first year, and half as much the second. The sums thus received are kept as a special fund and are employed by the firm in the instruction of apprentices during the term of apprenticeship, and, as far as they will reach, of those who in the judgment of the firm are especially promising but unable to pursue their studies after their term (three years of 200 working days each) has expired.

Sir W. G. Armstrong, Whitworth & Co., demand a heavy premium, even for apprentices; and expressly state beforehand that they do not guarantee a position in their works when the period of apprenticeship is over; on the contrary, they emphasize the fact that the chance thereof is but slight.

In the Elswick Works of the above mentioned concern, apprentices are received either on payment of a

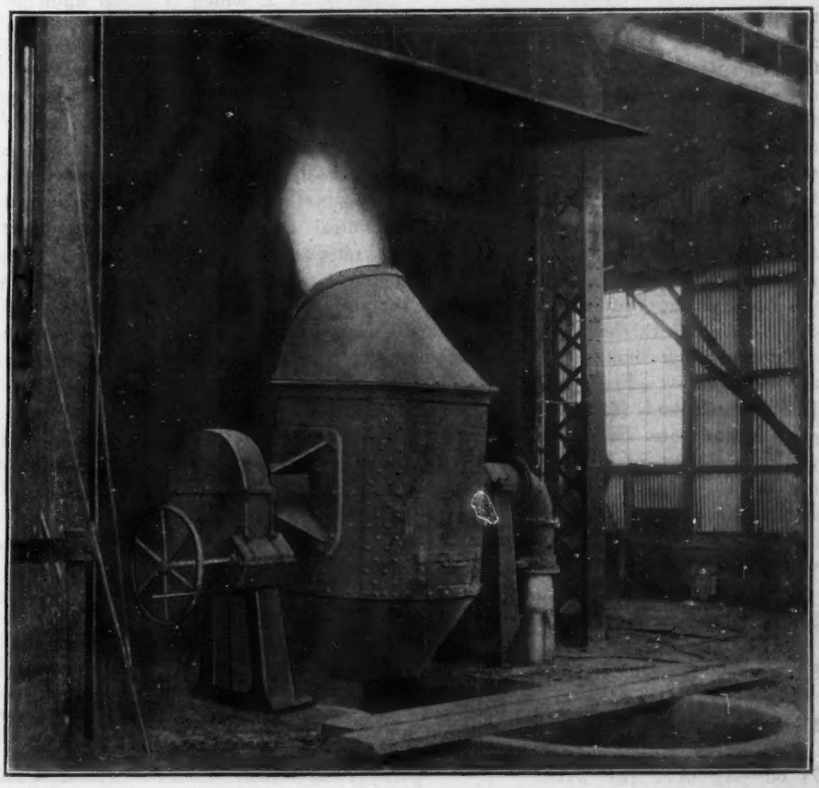


FIG. 5.

premium as in "Course A," or without premium as in "Course B."

The premium payable under Course A is as follows:

For two or three years 600 guineas —about $3,150.

For four years 700 guineas—about $3,675.

For five years 800 guineas—about $4,200.

A reduction, however, is made in the above scale in the case of anyone who has obtained a "first-class certificate" after a complete course of instruction extending over at least three years at an improved technical engineering college, or, who has a "first-class honors degree" in an approved engineering course at a university; and the reduced premium is as follows:

For two or three years 300 guineas —about $1,575.

For four years 350 guineas—about $1,838.

For five years 400 guineas—about $2,100.

A trial of one month is allowed, at the expiration of which period it is optional with either party to proceed or not with the indenture.

The amount of the premium is payable on the signing of the indenture at the expiration of the period of trial. The indenture dates from the commencement of the trial.

The most usual period of apprenticeship is three years, of which two are passed in the pattern shop, fitting and erecting shops, foundry, etc., and the last in the drawing office; so that apprentices under this course are enabled to gain an insight into more than one branch of manufacture—which is not the case under Course B.

The usual age for commencing work is about 19 years; but under this course apprentices can be received beyond this age.

The working hours in the shops are as follows: From 8:30 a. m. to 12:45 p. m., and from 2 p. m. to 5 p. m., except on Saturdays, when the works close at noon. In the drawing office, work is from 9 a. m. until 12 noon, and 2 p. m. until 5 p. m., except on Saturdays, when work ceases at 12:30 p. m.

Apprentices receive wages on the following scale:

During the first year, 3s 6d—say 87 cents per week.

During the second year, 5s 6d—say $1.37 per week.

During third and remaining years, 7s 6d—say $1.87 per week.

Subject to the condition that a minimum number of 33½ hours per week be worked.

**Course B.**

Apprentices who enter for this course pay no premium and receive wages according to age and ability under one of the three following scales. The age of entering is from 15 up to 17, and the period of apprenticeship terminates when the age of 21 is reached.

**Scale 1.**

Apprentices are paid under this scale unless they possess the qualifications entitling them to wages under Scales 2 or 3. The wages under Scale 1 are as follows:

During the first year, from 6s to 7s 6d—say $1.50 to $1.87 per week.

During second year, from 7s to 9s —say $1.75 to $2.25 per week.

During third year, from 8s to 11s —say $2 to $2.75 per week.

During fourth year, from 9s to 14s —say $2.25 to $3.50 per week.

During fifth year, from 10s 6d to 15s—say $2.62 to $3.75 per week.

During sixth year, from 12s to 15s —say $3 to $3.75 per week.

**Scale 2.**

If an apprentice has obtained a technical college certificate, or has obtained the Oxford or Cambridge school certificate, he receives wages under scale 2, which is based upon an increase of 4s on the rates given in scale 1.

**Scale 3.**

If an apprentice has obtained a first-class certificate after a complete course of instruction extending over at least three years at an approved technical engineering college, or has a first-class honors degree in an approved engineering course at a university, his wages are paid under scale 3, which is based upon an increase of 6s, say $1.50 per week on the rates given in scale 1.

The working hours in the shops under course B are from 6 a. m. to 8 a. m., from 8:30 a. m. to 1 p. m., and from 2 p. m. to 5 p. m.; except on Saturdays, when the works close at noon. Apprentices under this course are not received in the drawing office except under special circumstances. In the shops they are only apprenticed to one particular trade, such as pattern making, founding, machine work, or fitting and erecting; and are not moved from shop to shop as in course A, unless it be for the convenience of the company.

Of course apprentices entering for either course are expected to conform strictly to the rules and regulations of the works.

In the well known shops of the Bollinckx Society in Brussels, there have been no apprentices for the last 30 years, for the very simple reason that it is impossible to get employes to sign any sort of agreement.

The corps of workmen is formed by choosing from the helpers the most intelligent. They go first through the drilling department, where they become familiar with the machines there found, and learn to oil up, to set the work in the machines, etc. In this department there are several periods with successive increase of pay, as the hands pass from the most simple to the more complicated machines. Then they are passed on to the boring department. In the turning shops the men commence on the revolver lathes or screw machines; and the same system is pursued with the planer hands and those in the milling department. No one is taken on under 18 years of age.

In the world-famous automobile and motor works of De Dion Bouton & Co., Puteaux, France, there are but few volunteers; those who work there as such being young men who wish to learn the automobile thoroughly and practically, and who are permitted to run about in the shop, upon specially private recommendation. They receive no pay; on the other hand, pay nothing for the privilege of working and learning. They are held to no particular hours of coming and going; are, however, bound to observe the general shop rules in the matter of discipline. They may be said not to belong to the establishment, and may be classed apart from the apprentices, who, no matter how little they may perform, receive pay for doing it.

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## GOVERNMENT'S COPPER STATISTICS FOR 1908.

The United States geological survey's report on the production of copper gives the total production in 1908 by smelters from copper-bearing material mined in the United States as 942,570,721 pounds, the largest in the history of the industry. The production in 1906, the next largest, was 917,805,682 pounds; that for 1907 was 868,996,491 pounds. The world's production of copper in 1908 was 1,667,098,000 pounds, so that the United States contributed considerably more than half the total product of the metal.

# TESTS OF THE MELVILLE-MACALPINE REDUCTION GEAR

## Results of the Most Elaborate and Costly Private Experiments Ever Conducted

Among the distinct developments of 1909 is the speed-reduction gear devised by Rear Admiral George W. Melville and John H. Macalpine, concerning which the first American publication appeared in *The Marine Review,* Cleveland, and which has since been noticed in the engineering press gen-

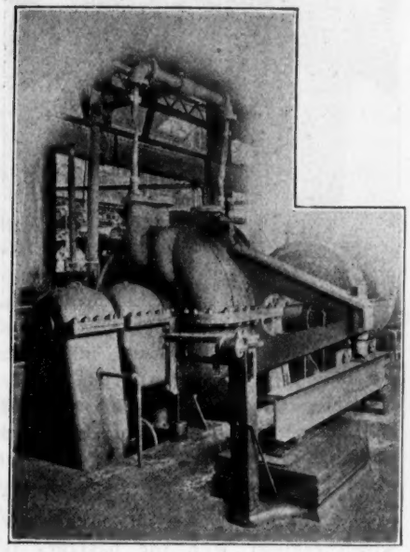


FIG. 1.

erally. Although the apparatus was designed primarily for marine use in order to permit of the use of a high speed turbine in conjunction with a moderate or low-speed propeller, it should be equally applicable in other cases where a positive and compact connection between the prime mover and the driven apparatus is desired. Incidentally while permitting of the use of positively connected turbines and propellers, each running at its most efficient speed, it also makes for a substantial reduction in space and in weight, the latter not only in itself but in reduction in fuel carried due to the higher economy attainable by reason of taking fullest advantage of rotor speeds and steam velocities. A most complete series of tests were undertaken by the Westinghouse Machine Co., East Pittsburg, Pa., builders of the gear, in order to determine its capacity and efficiency and in order to do so it was necessary to provide some form of brake or dynamometer that would be capable of absorbing a continuous output of 6,000 effective horsepower, and the following particulars of this brake and of the tests conducted therewith are from information supplied by the Westinghouse Co.

A brake of this capacity was in its way as entirely unprecedented as the gear itself. In any form of mechanical brake, the energy is transformed into heat, and in dealing with such large powers as were contemplated, the problem of carrying away the heat generated becomes a very serious one. When one recalls that the quantity of heat generated by the absorption of one horsepower is 2,545 British thermal units per hour, or about one-fifth that resulting from the combustion of a pound of coal, one is better able to comprehend the magnitude of the problem, by making the simple calculation that shows the total quantity of heat to be dealt with, is practically that which would be generated in a furnace burning coal continuously at the rate of 1,200 pounds per hour.

An ordinary band or "Prony" type of friction brake was entirely out of consideration, as the speed would limit the diameter of the brake wheel to 6 or 7 feet, and its face would have to be not less than 30 feet. The difficulties involved in the construction, and the cooling of such a brake, and the maintenance of the proper tension on a brake band of this width are practically insurmountable.

Naturally the first thing to suggest itself was the use of a dynamo-electric machine with a water rheostat for adjusting and maintaining the load. Such a generator would be cumbersome and expensive, the windage and electrical losses would vary with different loads and speeds, and there would always be an uncertainty as to the exactness of the allowances made for these losses. Neither are the most careful electrical measurements quite as satisfying and convincing as direct comparisons with the familiar force of gravity.

The idea of the electrical dynamometer was therefore abandoned because of the uncertainty that its indications would be sufficiently exact to enable the transmission loss in the gear to be determined with any reasonable degree of finality, as it was hoped

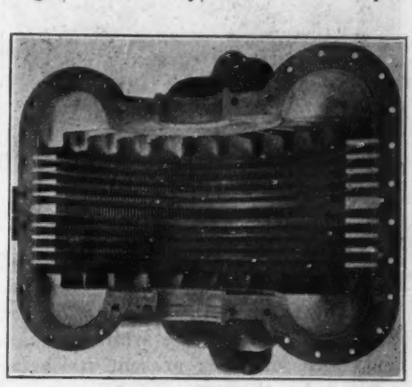


FIG. 3.

that this loss would be very small, and possibly within the probable limits of accuracy of this method of measurement.

For a number of years The Westinghouse Machine Co has successfully employed a form of hydraulic brake for measuring the power developed in the works tests made on all steam turbines manufactured by it. This form of brake consists of a rotor mounted on a shaft coupled to the shaft of the turbine, and rotating within a closed casing supported on journals through which the rotor shaft passes. The casing is held against turning by means of a radial arm bearing against a vertical strut, the lower end of which rests on an ordinary platform scale. Within the casing is a quantity of water, which quantity may be maintained constant at any desired amount by means of

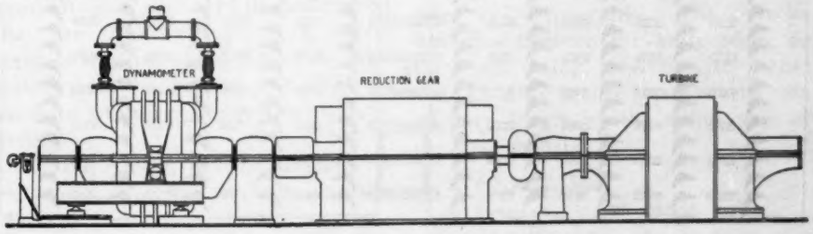



FIG. 2.

inlet and outlet pipes with adjustable controlling valves. The rotor has a series of vanes or teeth on its periphery which tend to impart a rotary motion to the water contained in the casing. The inner surface of the casing is provided with vanes or teeth which resist this tendency, and the

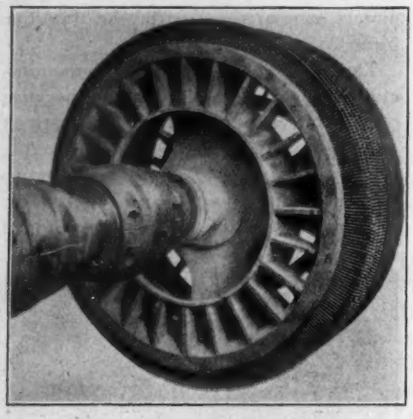


FIG. 4.

result is a powerful braking action, the intensity of which can be regulated by the quantity of water in the casing. The resistance which the casing must offer to prevent its being rotated by the water striking its inwardly projecting vanes at high velocity is measured by the pressure exerted on the platform scale by the strut under the radius arm, and from this pressure, the effective length of the radius arm, and the number of revolutions per minute, the power is calculated in identically the same manner as in the case of an ordinary Prony or band brake. As a matter of course, the temperature of the water is quickly raised to the boiling point, and a considerable portion of it evaporates, and in the form of steam easily carries off the enormous quantities of heat generated. The amount of fresh water admitted to compensate for the quantity lost by evaporation and through the overflow pipes, is constantly adjusted by the attendant in such a way as to keep the scale at all times in perfect balance.

The successful brakes constructed on this principle had all been designed for high speeds, ranging from 750 revolutions per minute for the largest, up to 4,000 or more for the smallest sizes. In order to adapt the same principle to a brake that should have the requisite capacity and stability at the lower speeds of the driven shaft of the reduction gear, the radically new design, of which a detailed description follows, was developed by Raymond N. Ehrhart of The Westinghouse Machine Co.'s Engineering staff.

Unfortunately, the space between the experimental plant and the wall of the building in which it is located is too restricted to enable a satisfactory photographic view to be made of the complete installation, comprising turbine, reduction gear and dynamometer. The line drawing (Fig. 2), however, shows clearly and correctly the disposition and relative proportions of the several component parts.

Fig. 1 on page 83 is a general view of the dynamometer, and the arrangements for weighing the load. On account of the heavy pressures to be dealt with, the resistance of the radius arm is not taken up directly on the platform of the scale, but is transmitted through a knife edge bearing to an I-beam, one end of which rests on a solid foundation and the other end on the platform of the scale. The I-beam also rests on knife edge bearings at either end, and forms a lever of such proportions that only one-fourth of the total stress comes on the scale. At the top of the dynamometer will be seen the flexible hose pipe connections for admitting the water to the interior of the casing.

Fig. 3 is a view of the interior of the upper half of the casing, and shows the stationary vanes which resist the impulse imparted to the water by the rotor. These vanes are inserted and supported in precisely the same manner as the blades in the cylinder of a steam turbine.

Figs. 4 and 5 are two views of the rotor, bladed with regular steam, turbine blading sections, the rows on one side of the center being of

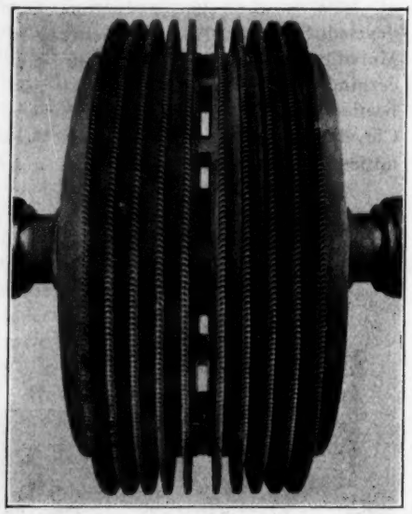


FIG. 5.

what is called "right hand section" and on the opposite side of "left hand section."

The water enters the top half of the casing through ports on either side which register with the passages in the side of the rotor clearly shown in Fig. 4 just inside the rim. Through these passages the water is carried to the middle of the rim of the rotor and is discharged through the ports shown in Fig. 5, between the two innermost rows of blades.

With the aid of the diagram, Fig. 6, a developed cross section through the blades, the action that next takes place will be readily understood. The moving blades are shown in solid and the stationary blades in cross-lined section. The water emerges with a whirling motion from the port A, and immediately meets the broad central row of stationary vanes which check its angular velocity. It escapes to the right and left from the passages between the central row of stationary vanes and is picked up by the first row of moving blades on either side. These moving blades again impart a high angular velocity to the water, and by reason of the curvature of their section project it into the adjacent rows of stationary vanes, where the velocity is again checked. This action is repeated as the water passes through the successive rows of mov-

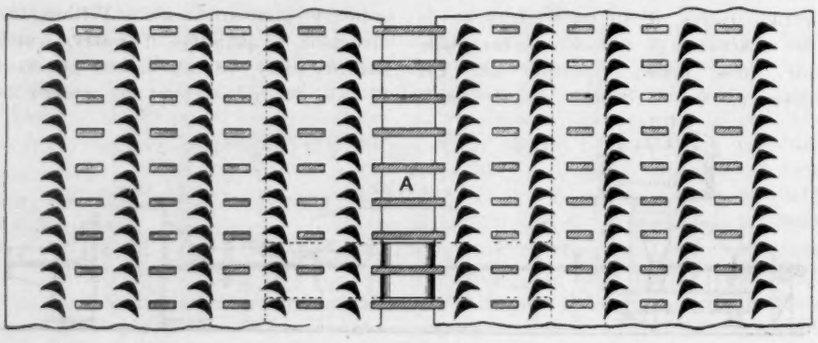



FIG. 6.

ing and stationary blades, until it reaches the outermost rows of moving blades.

From these last rows of moving blades the water is projected into circumferential passages of semi-circular cross section in either end of the casing.

These passages are shown at B in Fig. 7, a partial cross sectional view through the rotor and casing. At intervals in these circumferential passages are baffles to again check the angular velocity of the water. These baffles are shown plainly in Fig. 3, inside view of upper half of casing. The passages in the casing re-direct the water into the rotor—or at least so much of it as has not been already evaporated—and the entire cycle of operation is repeated indefinitely.

Fig. 8 is a section through the assembled dynamometer. The passages through which the water enters are indicated by the letters C and $C^1$. D and $D^1$ are vents for the escape of the steam generated by the transformation of the mechanical energy into heat. It is not practical to carry off all of the heat by evaporation alone, as the generation of 15,000 pounds of steam per hour in the casing would cause such a violent boiling as to interfere with the stability of the braking action. Consequently the quantity of water admitted into the casing is considerably in excess of the quantity evaporated, and the surplus is discharged at boiling temperature through the passages E and $E^1$.

The dynamometer measures the output of the gear with the utmost precision, but in order to determine the transmission loss, it is imperative that the input should also be known. An extensive series of tests was carried out in which the power was measured by a dynamometer attached directly to the shaft of the turbine. It was found that for each speed and load, with a constant vacuum and with steam of uniform quality, there was a corresponding inlet steam pressure. By often repeated trials it was found that by reproducing any particular set of conditions of speed, inlet pressure and vacuum, the brake load could be predicted with unfailing accuracy. This fact being thoroughly established it was only a matter of a long and tedious series of routine trials to calibrate the turbine for all of the loads and speeds at which the plant was to be tested. As a variation in the vacuum has the most serious influence on the power of a steam turbine, all other operating conditions remaining the same, the calibration tests were made with an abnormally poor vacuum, so as to allow a more ample margin for control, than would be possible if it had been attempted to maintain a vacuum that would more nearly tax the capacity of the air pump.

The dynamometer, notwithstanding that it was an entirely new creation, has operated in the most gratifying manner as regards steadiness, sensitiveness, and capacity, and in general has creditably upheld its part in what is perhaps the most extensive laboratory experiment that has ever been undertaken and carried out by strictly private enterprise.

### The Result of the Tests.

When the Melville and Macalpine experimental reduction gear was first erected and started on Sept. 7, 1909, extensive preparations had been made to determine the efficiency of the apparatus on the assumption that there might be a transmission loss of at least 5 per cent. After calculating the results of a few preliminary trials, it was found that the apparent efficiency was over 98 per cent, and this raised the perplexing question as to how to determine this unexpectedly small transmission loss with a satisfying degree of exactitude.

If the efficiency were only from 90 to 95 per cent, its measurement, within reasonable limits of accuracy, would have been an easy matter. Rising as it unquestionably does, above 98½ per cent, it will be readily understood that the problem requires a refinement of method, and a degree of painstaking care far beyond that which is usual in ordinary engineering investigations.

For the reason that the efficiency is so remarkable, it has been thought advisable to describe the methods employed and to tabulate the principal observations with a minuteness of detail that might, in many cases, be considered superfluous, if not actually wearying.

Naturally the first trials of the gear were made at very moderate speeds and loads, with frequent stops to examine the condition of the teeth and bearings. During the first few days the speed was gradually raised to 1,500 revolutions per minute of the turbine shaft, and 300 revolutions of the gear shaft, and a load of over 6,000 brake horsepower was carried. The load was limited only by the power of the turbine, as there were no indications that the ultimate safe capacity of the gear had from any standpoint been nearly approached.

On Saturday, Oct. 16, 1909, an endurance test at maximum load and speed was started at 3:15 p. m., and continued until 7:15 a. m. on the following Monday, or a total of 40 hours. This test was witnessed by Commander R. S. Griffin, U. S. N., and Lieutenant-Commander U. T. Holmes, U. S. N., specially delegated for this purpose by the Bureau of Steam Engineering of the United States Navy Department.

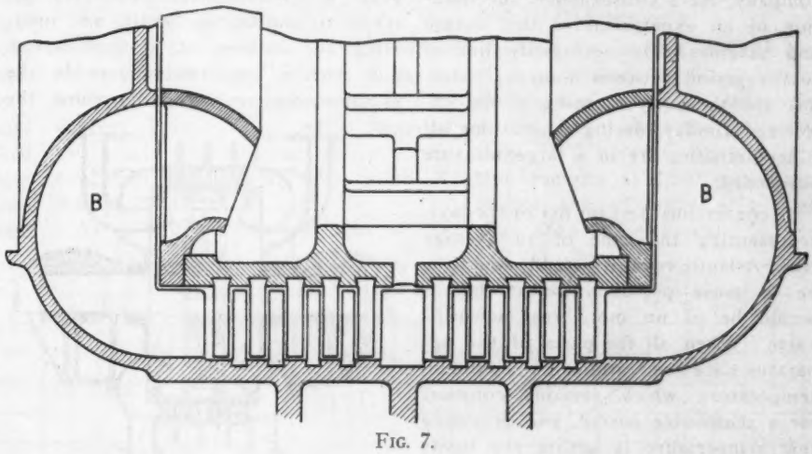


FIG. 7.

The load was applied by the hydraulic dynamometer described on the preceding pages. The radius arm of this dynamometer is 6½ feet, and the pressure exerted is transmitted to the platform scale through a lever having a ratio of approximately 1 to 4, as shown in Figs. 1 and 2 on page 83 in the detailed description of this piece of apparatus. The precise distances between the knife edges on the lever being, however, 18 inches and 72 5/32 inches respectively, the effective length of the radius arm of the dynamometer is

$$\frac{6.5 \times 72.15625}{18} = 26.056 \text{ feet.}$$

The constant for one pound pres-

sure on the scale, and one revolution per minute is consequently

$$\frac{26.056 \times 2 \times 3.1416}{33000} = 0.0049612 \text{ horsepower.}$$

During this trial the following average conditions were maintained:

| | |
|---|---|
| Gross weight on scale, pounds | 4443.4 |
| Dead weight on scale, pounds | 388.0 |
| Net weight on scale, pounds | 4055.4 |
| Speed, revolutions per minute | 300.6 |
| Brake horsepower | 6048.0 |

There was nothing in the operation of the gear to indicate that this load might not be carried indefinitely. It will be readily understood that a constant draft of 6,000 to 7,000 horsepower on the boiler plant of an industrial establishment like the Westinghouse Machine Co. could not be long maintained without interfering with the regular operations of the company. As a consequence, the duration of an experiment of this nature and magnitude is necessarily limited to the period between noon on Saturday and the early morning of the following Monday, during which time all other activities are in a large measure suspended.

A continuous test for five or six days, representing the time of an average trans-Atlantic voyage, would doubtless be of more popular interest, but it would be of no more real scientific value. When all the parts of the apparatus have once attained a maximum temperature which remains constant for a reasonable period, and providing that temperature is within the limits generally recognized as conservative, a condition has been established which is capable of being maintained indefinitely. No useful data could be obtained from a further prolongation of the trial, excepting the very probable development that as the wearing parts became polished and took on a better surface, the operation of the apparatus would improve. In the present instance the trial continued over 34 hours after the temperature conditions had become constant.

With the dynamometer described on pages 83 and 84 the measurement of the power output of the gear becomes a very simple matter. But to determine at the same time the effective power input, is an engineering problem that is more than a little out of the ordinary. If the gear were driven with a reciprocating engine, the natural procedure would be to measure the indicated horsepower, and either estimate or measure the friction of the engine, and thus obtain a correction which, when applied to the indicated horsepower, would give the effective power delivered to the gear.

There being no way in which to measure the indicated horsepower of a steam turbine, it became necessary to establish the exact brake horsepower in some other way. Happily, there is one characteristic of the steam turbine that makes it possible to calibrate any particular machine, in such a way that its output in effective horsepower at any instant may be determined with greater accuracy than it is possible to determine even the indicated horsepower of a reciprocating engine. As long as the speed and exhaust pressure are maintained constant, the absolute inlet pressure of commercially dry steam, at any instant, is a very accurate measure of the brake horsepower the turbine is developing.

By substituting for the reduction gear, a dynamometer connected directly to the turbine shaft, and operating the turbine at a fixed speed and with a constant vacuum in the exhaust pipe, we may determine the

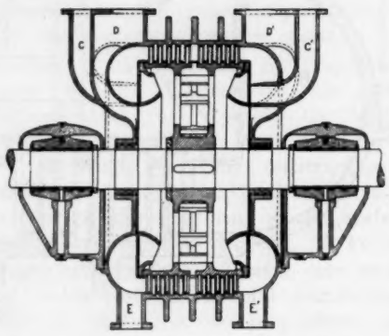


FIG. 8.

inlet pressures corresponding to different loads at this speed.

Plotting these observations on a diagram in which the ordinates represent absolute pressures per square inch, and the abscissae represent brake horsepowers, and drawing a line through the several points, we get a scale by means of which the horsepower corresponding to any inlet pressure may easily be read. This line is practically straight, so that readings made between the points representing actual observations, are quite dependable.

The diagram in Fig. 9 shows the calibration of the turbine used on these tests at 1,500 revolutions per minute with a vacuum of 22.78 inches, corrected to a barometric pressure of 30 inches.

The radius arm of the high speed hydraulic dynamometer used in calibrating the turbine is 48.375 inches. The constant per pound pressure on the scale is therefore

$$\frac{48.375 \times 2 \times 3.1416 \times 1500}{12 \times 33000} = 1.1513$$

**Table I.**

| Inlet Pressure Absolute. | Gross Weight on Scale. | Dead Weight on Scale. | Net Weight on Scale. | Brake horsepower. |
|---|---|---|---|---|
| 109.6 | 3,585 | 385 | 3,200 | 3,675 |
| 114.8 | 3,755 | 385 | 3,370 | 3,880 |
| 119.3 | 3,925 | 385 | 3,540 | 4,076 |
| 124.3 | 4,095 | 385 | 3,710 | 4,271 |
| 128.8 | 4,265 | 385 | 3,880 | 4,467 |
| 133.3 | 4,435 | 385 | 4,050 | 4,663 |
| 139.3 | 4,690 | 385 | 4,305 | 4,956 |
| 143.8 | 4,860 | 385 | 4,475 | 5,152 |
| 147.3 | 5,030 | 385 | 4,645 | 5,348 |
| 151.8 | 5,200 | 385 | 4,815 | 5,543 |
| 157.8 | 5,455 | 385 | 5,070 | 5,837 |

Table I gives the observed absolute inlet pressures, loads on scale, and calculated brake horsepowers over a considerable range above and below 5,000 horsepower. From these observations and calculations, a calibration curve similar to that shown in Fig. 1, was drawn to a large scale so that small differences of loads and pressure could be read accurately.

With the reduction gear connected to the turbine, a number of observations were made of the absolute inlet pressures corresponding to practically the same range of loads transmitted through the gear to the slow speed hydraulic dynamometer.

In these tests, as well as in the turbine calibrations, at every load before reading the inlet pressure, the speed of the turbine was brought exactly to 1,500 revolutions per minute as indicated by a vibration tachometer, and the vacuum adjusted to exactly 22.78 inches corrected to a barometric pressure of 30 inches. The vacuum was purposely carried abnormally low by bleeding a small quantity of air into the exhaust pipe. By means of a small valve in the air inlet pipe, the vacuum could be quickly and accurately adjusted to the arbitrary standard without its being necessary to make any change in the speed of the air pump or the quantity of the circulating water.

The gear and pinion having respectively 176 and 35 teeth, the speed of the driven shaft would be 298.3 revolutions per minute. The horsepower constant of the dynamometer is, as stated above, 0.0049612.

In Table II, column 1, are the observed absolute inlet pressures corresponding to the different loads transmitted through the gear as set down in column 5. In column 6 are given the horsepowers of the turbine alone corresponding to the same inlet pressures, as determined from the calibration curve. Obviously, the quantities in column 5 represent the power output of the gear, and those in column 6 represent the power input. The

quantity in column 5, divided by the quantity standing against it in column 6, gives the efficiency as it appears in column 7.

**Table II.**

| Inlet Pressure Absolute. | Gross Weight on Scale. | Dead Weight on Scale. | Net Weight on Scale. | Brake Horsepower Delivered by Gear. | Brake Horsepower of Turbine from Calibration Curve. | Efficiency. |
|---|---|---|---|---|---|---|
| 111.8 | 2,900 | 388 | 2,512 | 3,712 | 3,771 | 98.7 |
| 122.3 | 3,200 | 388 | 2,812 | 4,156 | 4,197 | 99.0 |
| 132.3 | 3,480 | 388 | 3,092 | 4,576 | 4,623 | 98.9 |
| 142.3 | 3,791 | 388 | 3,403 | 5,036 | 5,108 | 98.7 |
| 152.3 | 4,100 | 388 | 3,712 | 5,486 | 5,567 | 98.5 |
| 162.3 | 4,400 | 388 | 4,012 | 5,927 | 6,057 | 98.7 |

While the efficiencies as calculated from these observations are consistent and uniform over the whole range of observations, the total transmission loss as shown, almost falls within the limit of the normal error that might reasonably be expected in measuring such large total quantities of power. And in spite of the fact that the greatest precautions were taken to insure accuracy, the readings being checked by several observers, and the gages and scales being standardized before and after each trial, one would feel some hesitation in vouching for these efficiencies if there were no way of checking them. Fortunately, a satisfactory check is available.

The gear is lubricated by circulating a copious supply of oil under a head of about 10 pounds, through the bearings, and through a spray which plays continuously on the teeth of the wheels. The transmission loss in the gear therefore appears as heat in the oil. The heated oil coming from the gear is passed through a cooler which is very like a surface condenser with cold water circulating through the tubes.

By measuring the quantity of oil circulated and noting the rise in temperature in passing through the gear, a close approximation of the number of British Thermal Units lost per hour in friction is obtainable.

At a load of 5,088 horsepower delivered by the gear, 591 pounds of oil were circulated per minute, with an average rise in temperature of 9.86 degrees Fahr. The specific heat of this oil is 0.47, and consequently the total heat absorbed per hour is $591 \times 0.47 \times 60 = 164{,}208$ B. T. U.

As 2,545 B. T. U. per hour is the equivalent of a horsepower, the total heat accounted for in the oil is

$$\frac{164{,}208}{2{,}545} = 64.17 \text{ brake horsepower.}$$

The brake horsepower being 5,088, and 64.17 horsepower being accounted for by the heat in the oil, the efficiency by this method of calculation would be

$$\frac{5{,}088}{5{,}088 + 64.17} = 98.75 \text{ per cent.}$$

This figure is probably a little too high as there is an indeterminate small quantity of heat radiated from the gear casing and from the oil piping that has not been accounted for. Even if this were 20 per cent of that accounted for, which is most improbable, the efficiency indicated would still be 98.5 per cent.

Giving due weight to both methods of measurement, and considering the closeness of agreement between them, it is quite evident that at approximately 5,000 horsepower, with the turbine running at 1,500 revolutions per minute, the efficiency of the gear is more than 98.5 per cent.

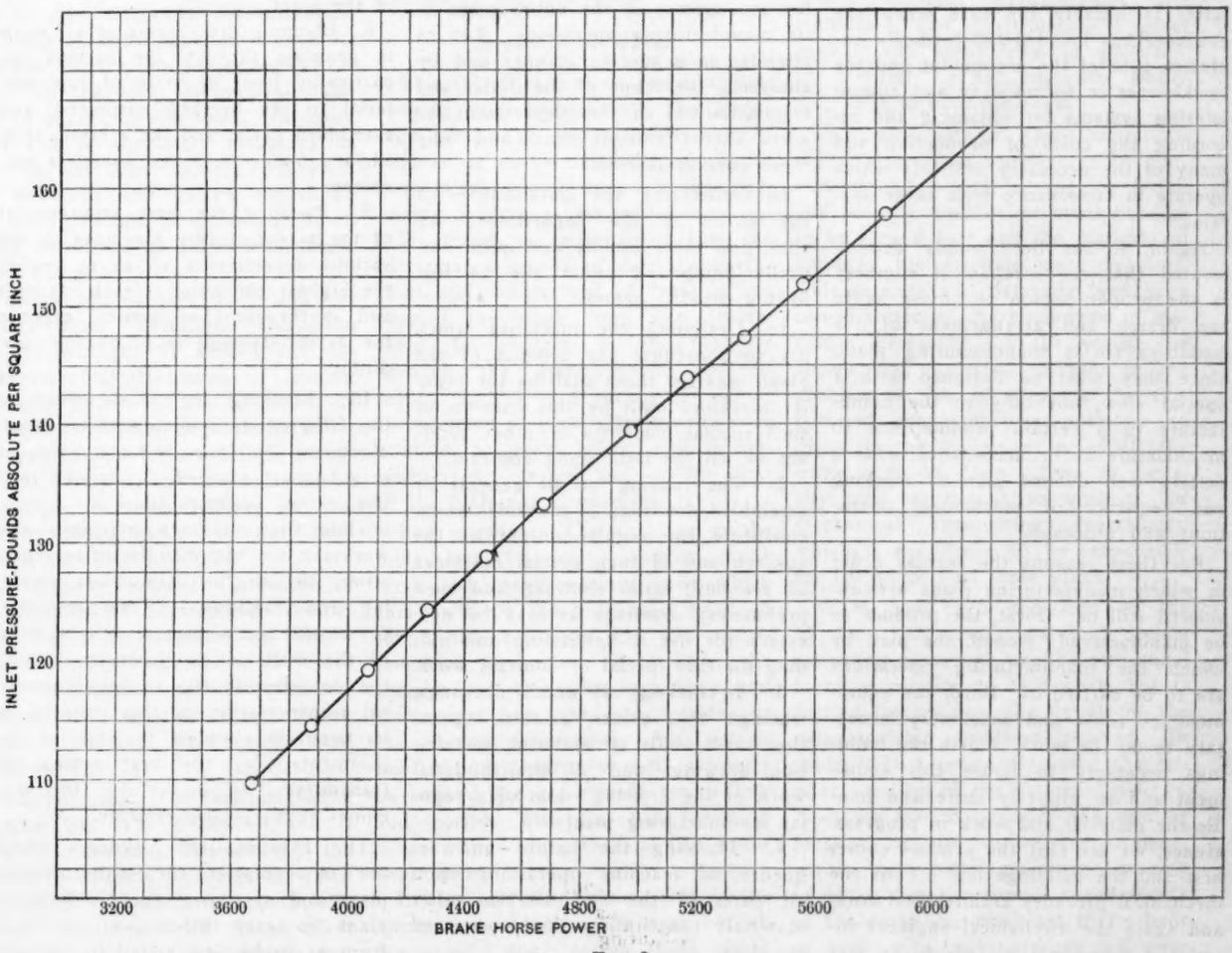



FIG. 9.

# THE SCOPE AND DUTIES OF THE MECHANICAL ENGINEERING DEPARTMENT

By Oscar E. Perrigo, M. E.

It may not have been very generally observed, but is nevertheless true that the scope and the duties of the mechanical engineer are being greatly extended year by year. Not so many years ago the duties of the mechanical engineer were very largely, if not in many cases entirely covered by his work of designing machinery, supervising the making of the drawings and the building and testing of the machinery built from them. With these duties quite naturally, came the work of making estimates upon which bids for new contracts might be based.

The more recent developments however, have added many duties incident with the preliminary to those formerly considered of a strictly engineering nature. In some cases these duties have been correlative, while in others they have been extended into what may be considered new fields. The latter is notably the case when the engineer has invaded the formerly exclusive field of the accountant and the bookkeeper in formulating and administering systems for obtaining and recording the costs of production and many of the necessary methods which operate in consonance with these systems.

Again, it has been amply demonstrated that the mechanical engineer is the proper person to advise as to the design and arrangement of the buildings for a manufacturing plant, since they must be designed with a special view, not only to the manufacture of a certain product, but to manufacture it in accordance with a certain well defined plan of working and sequence of mechanical operations and processes.

For these reasons the regular order in which manufacturing plans are considered will be: First, the product to be manufactured; second, the plan by which the manufacturing operations are to be carried on; third, the equipment of tools and machinery necessary to do the work; fourth, the buildings necessary to house this equipment and to properly store and handle the material and work in progress. Hence, we see that the product comes first and the buildings last. Thus the mechanical precedes architectural work, and again the mechanical engineer invades a new field to which he was formerly considered a comparative stranger.

Therefore, we may say that when superficially considered, the general purposes of the mechanical engineering department is to produce drawings, tracings, blue prints, etc., for the use of the manufacturing departments, and that while this includes a large volume of the work of the draftsmen and assistants who make up the working force of this department, and considering that this work is one of much importance as to the accuracy of the product and the efficiency of the system by which it is carried on, it is not by any means the most important work for which the department is responsible.

### Classification of Duties.

In a much broader and more comprehensive view, however, this department is responsible to a great extent for the success of the entire plant in its manufacturing operations. Let us consider in a specific manner and by analyzing the scope of the duties and responsibilities of this department, to what extent this is true, and why these conditions exist.

In considering the classification of the duties of the departments we shall find them usually and quite naturally comprised under the 14 following heads, namely:

1. Designing the machines which are to constitute the product of the plant, whether these shall be the regular machines built by this concern or such special machines or other product as will be built upon contract.

2. The making of all general or assembled drawings of machines which constitute the regular output of the concern and of such special machines as are built upon contract, and such preliminary drawings as may be necessary for use in estimating and bidding for this special or contract work.

3. In making all detail drawings, tracings, blue prints, machine operation cards, bills of material, installation drawings and all similar detail work of the drafting room of a regular manufacturing plant.

4. Planning the nature and sequence of machine operations upon all parts of the machines or other materials constituting the product of the plant.

5. Devising methods for systematizing all machine and hand operations, and making accurate time studies of the same; with a view to increasing the efficiency of men and machines by accurate records and comparison of past and present performances.

6. Selecting such of the machines forming the equipment of the manufacturing departments as may be purchased from machine tool builders, and designing such special machines as cannot be purchased.

7. The designing of such special tools, jigs, and fixtures as may be necessary to accurately and economically manufacture the regular and special output of the plant. This will require much study and special abilty, and will call for an accurate knowledge of machine operations, of the exact nature of the product and the variety and capacity of the equipment of the plant.

8. Planning the routine of all work in progress through the various departments from its state of raw material to the finished, inspected, and assembled parts; and the erected, tested, and finally inspected complete machines.

9. Planning the best arrangement of the manufacturing machines in the various departments so as to realize the highest efficiency of each machine and at the most economical expense for its maintenance in productive condition.

10. Planning the arrangement of the different departments of the manufacturing buildings in such form as may be best adapted, (a) to the relative extent of floor space to accommodate the necessary machines and workmen for the manufacturing operation; (b) to the economical receiving and handling of raw material; (c) to the best system for the routing of the work in its progress through the department; (d) to the economical transportation of this material in its progress through the various departments; (e) the best system of transmission of power for the machines in these departments.

11. Planning the buildings which are to comprise the manufacturing plant and arranging the buildings in plant to each other, (a) in such form as to be best suited to the site

upon which they are to be built, utilizing all of the natural advantages available; and (b) in such form as to be best adapted to the maufacture of the product to be turned out.

12. Planning the system for the generation and transmission of power so as to be best adapted to economically furnish power to all the departments of the plant.

13. Planning an efficient and economical system of transportation for both yards and shops, and including floor and overhead tracks, trolleys, traveling cranes, elevators, etc.

14. Planning a complete, accurate and economical system for ascertaining and recording the costs of the product of the plant, including the three factors of material, labor and general expense or overhead burden.

### Varied Character of Work.

Upon a careful consideration of these 14 general classes and the duties and responsibilities arising therefrom, the immense volume and varied character of the work of the modern mechanical engineer may be realized.

The important nature of this work and its special features frequently lead to the employment of consulting engineers of large experience upon its different phases, in an advisory capacity to the local mechanical engineer in charge of the work. In many cases this is absolutely necessary as scarcely, any one engineer will have had sufficient and varied experience that would fit him as an expert in all of the 14 classes of engineering work above outlined.

While much of this work and the responsibilities resulting therefrom may be managed by skilled and experienced chief draftsmen or leading draftsmen in the several divisions of the work, the chief engineer is primarily responsible for its design, accuracy and timely completion so as to be ready for its various uses in the different departments at the time when it is required.

To properly analyze the work of the mechanical engineering department it will be necessary to take it up by classes as indicated in the foregoing classification so that the importance of each class may receive its due portion of consideration and careful study.

Assuming that the manufacturing company has been organized and is about to commence business by the erection of suitable buildings in which to carry on manufacturing operations, the first requirement will be to effect the organization of a preliminary mechanical engineering department, which shall be available for the initial work.

The head of this department, the chief engineer, will usually have the services of a consulting mechanical engineer and frequently for a time at least, a civil engineer and surveyor, or an architect, or both, to assist with their advice in selecting a proper site for the plant, the mechanical engineer taking up the special requirements necessary for the economical manufacture of the output and the architect advising as to the details of construction of the buildings, and the three engineers forming a board of experts whose services are well nigh indispensable in the inauguration of any class of manufacturing work that is to be of considerable importance and magnitude.

While it is possible and sometimes practical to put all these duties and responsibilities upon an architect conversant with the usual requirements of manufacturing buildings, there is one important factor in this question that, in this connection, must be taken into consideration if we are to take advantage of all the available resources that go to insure the future success of the enterprise.

### Sequence of Work.

This factor is that of designing, arranging and constructing the buildings comprising the plant in such a manner as to be best adapted to the economical manufacture of the particular product to be turned out.

It should be remembered that the particular sequence of machine operations and the method of "routing" or passing the work from one department to another in its progress through the manufacturing departments, control to a very great extent the location of these departments with relation to each other, and consequently the design and arrangement of the buildings themselves.

For instance. The machine to be built may be one requiring many large and heavy castings upon which there will be much planing work to range the buildings and the transportation equipment as to make the progress of these castings easy and economical from the iron foundry to the planing department. Adjacent to the planing department will naturally be located the department for drilling and boring, with the final erecting room within easy reach of this latter department.

In this case the lighter parts of the machine would be made near by, on the ground floor, or on those above it, according to their nature and the machine operations required for their production, and sent to the erecting floor as required.

In another case the product might be a machine in which even the frame work was composed of comparatively light castings with no planing operation required, this class of operations being performed on milling machines. The smaller parts of the machines might be composed largely of drop forgings and parts machined directly from bar stock.

### Product Considered First.

It is readily perceived that in this case the relative location of the foundry is a secondary matter, but that we must see to it that the drop forge department and the rough stores department are within easy reach of the milling department and the automatic machine department and that the transportation facilities for the transfer of these materials are direct, efficient and economical.

Thus the infinite number of different kinds and classes of manufacture present distinct and very frequently totally different circumstances and conditions, and consequently a great variety and complexity of problems for solution by the engineers whose duty it is to consider them.

In consequence of these conditions the proper initial problem to be considered and solved is, not the building, but the machine or other product to be turned out; and the methods of handling the machine work required. This process will naturally lead to a consideration of the equipment of machines necessary for the work, and shows that the vital element in the problem is that of planning the system of manufacturing previous to planning the buildings in which the work is to be done. This of necessity calls for the active work of the mechanical engineering department, which is eventually to be responsible for the success of these plans.

What has been explained in the be done. Obviously we must so arpreceding paragraph applies with equal force in relation to this work, but is carried further into the details of the manufacturing problems involved. In the former case we discussed the relative location of the various buildings. Now we are to consider the relative location of the various departments within these buildings, always bearing in mind that the special requirements of the particular machines to be built or product to be turned out will gov-

ern, or materially affect, all the details of the problem.

These requirements will be considered somewhat in detail and in the order in which they have been referred to in the serially numbered paragraphs above.

**Problems of Design.**

First. The designing of the machines which are to constitute the product of the plant, whether (a) these are the regular stock machines built by the concern; (b) such special machines as are built in contracts; or (c) whether the product is of any other similar mechanical work, taken as separate jobs or routine repair work.

Whatever may be the output of the plant there will probably be designing and more or less development work to be done, which will properly go to the mechanical engineering department as the initial department for all manufacturing operations. Often this work will cover a very wide range.

Frequently the product will be a new machine which has by successive stages been developed up to a point where it is working successfully, but from the very fact that it is the result of development, its various features and devices are more or less a growth of different ideas, rather than a design after a general plan based on some central or fundamental idea. Hence, the design and construction of the machines is not such as it is practical to build for the market either as an example of good engineering, good appearance, or economy of manufacturing. For these reasons the entire machine must be re-designed, with the idea always in mind of making it:

First, an attractive machine when completed.

Second, making it perform all its different functions as well, and if possible, better than the original.

Third, above all considerations making it, in all of its parts, a machine that can be manufactured economically and hence a machine which the sales department can put on the market at a fair profit.

Should this last result fail of realization, the entire work is in vain, since the success of every manufacturing enterprise must of necessity be based on its ability to make a profit on its product. This is, in business, the test which must and surely will be applied to the work of the entire force, the work of the department, and the efforts of individual men. By the inexorable rule of "the survival of the fittest," all must stand or fall before this test.

Second. The making of the general drawings. After all the study and labor of designing has been performed there still remains the arduous task of making the general or assembled drawings of the entire machine, showing its various elevations, plans, sections, etc., so that an accurate idea of the construction of every piece may be obtained, as well as the location of every part, and its relation to these groups of parts and to each other, as well as to the machine in general.

As these drawings and the dimensions given upon them are to serve as guides for all future work of the draftsmen, pattern makers, machinists and all mechanics, who have to deal with the building of the machines and the tools with which they are built, it is of the utmost importance that great care and extreme accuracy be insisted upon in every line and figure.

**Careful Study Necessary.**

The construction of these drawings gives ample opportunity for an exhaustive study of the entire machine, and the view taken of it by the engineers and draftsmen assigned to the work must be comprehensive as well as accurate. They should so thoroughly study the various features of the machine, the relations of these features to each other, and to the final purposes of the machine that "from the beginning they may see the end" and be fully assured that the end will be so successful as to reflect credit upon their ability as engineers, as well as upon the management of the manufacturing enterprises they represent in placing the machine upon the market.

In case the concern is building special machines and similar work on contracts, there will be many drawings or blue prints to be examined and reported upon and doubtless many preliminary drawings to be made from them. This work is frequently done for the special use of the sales department and in large concerns doing a considerable volume of it, a special organization under the leadership of a preliminary engineer takes care of this work.

At the same time such a division should necessarily keep in close touch with the regular mechanical engineering department, whose chief should be most competent to advise and counsel in its work. Otherwise the preliminary engineer may be led into schemes for the building of special machines of such form or design that they could not be successfully and profitably built. This will sometimes be the case when expensive special tools must be made, which have not been provided for.

The mechanical engineering department must keep a watchful eye upon all these and similar matters in which the spirit of commercialism in its desire to obtain contracts may lead to unprofitable and annoying complications through a disregard of the principles of good engineering or the practical plans for profitable manufacturing.

**Character of Drawings.**

Third. Making the detail drawings. This work will include a great variety of drawings, tracings, blue prints, brown or black prints, etc., and in most modern mechanical engineering departments, more or less of photographic work, as this department is the most appropriate and suitable for successfully carrying on this work. Classified, this work may arranged thus:

1. Detail drawings of all machine parts.

2. Tracings of all drawings from which blue prints are to be sent to any other department.

3. Brown or black prints, or prints made by any special process, either for use in the offices or manufacturing departments of the plant, or to be sent to actual or prospective customers.

4. Shop operation sheets, schedules, bills of materials, etc., for use in the offices and manufacturing departments.

5. Negatives and prints from the same, or machines, machine parts, machine operations, new tools, devices and improvements upon machines, etc., to be used as records or exhibits in and about the plant, or to be sent to parties outside of it.

The production of all these different classes of work will necessitate comprehensive and accurate records of every drawing, tracing, print or other sheet of information made. Also an accurate record of every such sheet issued, to whom and for what purpose, and when and by whom such sheets are returned after being used, in case the issue is not a permanent one.

Fourth. Planning the machine operations. In the modern methods and systems of manufacturing great stress is laid upon the planning and arrangement of machine operations and the regular order or sequence of these operations upon the same piece, on its way through the different departments.

In former times each department was equipped with such numbers, classes and kinds of machines as in

the judgment of the superintendent, master mechanic or factory manager seemed best fitted, in a general way, to turn out the work which the concern expected to produce. In the modern conception of the theory of manufacturing there is little place for generalities. Every unit composing the manufacturing equipment must be considered for its individual use and value, and its adaptability to some particular use in the scheme of manufacture. So also is the question of machining the different parts that compose the product to be turned out. Each and every part must be thoroughly studied and the conditions analyzed as follows:

**Consideration of Details.**

1. Of what material shall it be made?
2. What dimensions must be maintained with extreme accuracy?
3. What dimensions will come next in importance in this respect?
4. What dimensions may vary considerably without detracting from the fitting or practical utility of the piece?
5. How can the piece best be held or clamped for machining without injury or distortion?
6. What is the "working point" or surface from which all dimensions must be computed?

All these conditions are matters of vital importance in planning the machine operations upon the piece. Should the piece be one of complicated form, each of these points will assume additional importance, and still others are very likely to be encountered. These facts having been determined, the planning of the machine operations and their regular sequence may be proceeded with.

In the use of several types of machines which perform operations of a similar character, as planers, shapers, slotters, and milling machines, the choice must be made of the most available machine for the particular operation to be performed, the dimensions and weight of the piece, etc. Not infrequently special machines must be designed when the regular machines are not capable of performing the required operation.

There are many other points of similar importance to be encountered in this class of engineering work that are too numerous and complicated to discuss in this article.

**Sequence of Operations.**

Fifth. Planning the mechanical operations, both by hand and by machine and arranging them in their proper sequence, is a work requiring not only a high order of engineering ability, but a peculiar fitness for this particular class of effort, since the efficiency and thoroughness with which it is accomplished, the exact knowledge of the capacity and utility of each machine to be used, and of the operators that are to handle the parts, as well as a patient study of every detail, will be necessary to its successful outcome, from an engineering point of view. At the same time it should not be forgotten that the successful working of the manufacturing departments will very largely depend upon how well and thoroughly the mechanical engineers have done this work.

Not only must the proper sequence of operations be arranged to suit the piece to be handled, the machine to be used and the operative to be employed must be considered; but the manufacturing departments through which it must be passed and their relations to each other; in order that efficient and economical systems of transportation may be formulated and maintained for handling the work in progress.

Sixth. Having successfully accomplished the work described in the last paragraph the next step will be that of selecting the standard machine tools and general machines that are to be found in the market for making up the equipment of the manufacturing departments. In this work much special knowledge, ability and discriminating judgment will be necessary since the variety of machines in the market is very large and nearly every machine possesses some special and valuable features that commend it to favorable consideration. On the other hand, scarcely any machine is entirely devoid of some weak points or some point which render it somewhat less desirable for the special purpose for which it is to be used.

Notwithstanding the large variety of machines to be found in the market there will be some classes of work for which special machines must be designed. This will be another important work for the mechanical engineer, and will call for a high grade of engineering ability.

**Tools and Fixtures.**

Seventh. The designing of special tools, jigs and fixtures. To the mechanical engineer who has not had considerable actual experience in the special work of the designing of special tools, jigs and fixtures, and in studying the practical uses of them, this subject will seem devoid of much of its actual value and importance. It constitutes a special and very important division in the work of mechanical engineering and one in which there are comparatively few men who are entitled to be considered as experts. Special talent is necessary in this work and this must be supplemented by much study, experience and observation. So true is this that experts in this work invariably command much higher salaries than many whose work is more strikingly apparent and of a kind that attracts much more attention and favorable comment.

It is not unusual to find that the use of a set of tools designed by an expert in this work will reduce the cost of machine operations to a third or a fourth of the amount that has been expended in the use of an ordinary set of tools designed by the average draftsman, and which appear to be well adapted to the work. And not only this, but the added and very important condition will be accomplished by the expert; extreme accuracy can be obtained at points where accuracy is required, and extreme regularity of duplication in all the pieces of a large lot. In the work turned out from tools designed by the novice there is no certainty of real accuracy anywhere; neither is there even a certainty of a duplication of inaccuracies, but usually very great irregularity both in forms and dimensions.

**Routing of Work.**

From the foregoing it will readily be realized that the work of designing special tools, jigs and fixtures is one of the most important and arduous duties devolving upon the mechanical engineering department, and one which it must always be prepared to meet and carry out with ability, efficiency and economy.

Eighth. Planning the routing of the work. Next to the planning of the machine operations the important question is to devise a proper routing of the work in its progress through the various departments.

The manufacturing departments are supposed to have been so planned that work in progress will naturally move in one general direction from the condition of raw material to that of completed product, ready for shipment.

If there are many castings used in the work the foundry will be the starting point.

If the number of forgings predominate, this fact will govern the initial operations.

If a large majority of parts are made

from bar stock the importance of this fact must be taken into consideration.

If two or more of these different classes of material form the greater part of the stock used the departments furnishing them will be so located as to be within easy reach of the initial manufacturing department using them.

In any event the route from the rough stock store room to the general manufacturing departments should be as direct and convenient as possible so as to pass this stock along with equal facility to that from the foundry, forge shop, etc. This will necessitate a convenient location for the rough stock store room so that the routing of the material drawn from it will be at all times convenient and prompt.

It must also be considered that the same route cannot be taken by all classes of work, but that the routing of each particular piece must be arranged to suit the machine operations to be performed upon it so as to bring it to completion and ready for assembling with the related parts of the group to which it belongs in the most direct manner.

### Efficiency First Consideration.

This should be understood as not superseding the general plan of routing the work, but as necessary exceptions to it where the particular nature of the work renders such a change necessary or advisable. It should always be remembered that efficiency is the object to be attained above and beyond all things, and where general or special plans, or the theory upon which we are basing our plans, comes in conflict with practical utility and efficiency, we are to decide the matter in reference to practical results.

By wise planning of the routing of the work through the different departments much time of men and machines may be saved, unnecessary losses eliminated and the general efficiency of the plant enormously increased. On the other hand, by defective planning in this respect, the needless moving of material here and there, forward and backward, from floor to floor and back again, the entire legitimate profit of manufacturing operations may be wiped out.

Ninth. Planning the best arrangement of manufacturing machines. In arranging the machines of a department three factors must be taken into account in order to realize the highest efficiency of both the machines and the men, and to operate the machines in the most economical manner. These three requirements are:

### Location of Tools.

1. They should be arranged (as far as may be consistent with the terms of the second and third paragraphs) so as to accommodate the system to the proper transmission of power. For instance; if the space occupied by a certain department is quite long in proportion to its width, it may have been decided to transmit power to the machines contained in it by two long lines of shafting running along the opposite sides of the room. Such an arrangement will at once suggest placing the machines in two or four lines, according to the area of the floor space they occupy.

2. They should be arranged on such a plan as to be convenient to an efficient system of transportation, and in harmony with it. In the plan suggested in the last paragraph, if the machines are arranged in two lines, a track for shop cars will naturally run through the center of the departments; while if there are four lines of machines they may be effectively served by a line of track running through the center of each section, the dividing lines between which will be down the center of the room. Thus, in either case there is a line of machines on each side of the track which serves them.

3. The arrangement of machines must be made with reference to the class, size and kind of machines composing the equipment of the department. These may be machines all of the same, or a similar type; or there may be a considerable variety of kinds and sizes, brought together on account of some peculiarity of the product which renders such an assignment advisable, expedient or necessary. In some cases such a condition is necessary in order to avoid retrograde movements of the work in progress. In other cases a regular sequence of machine operations may necessitate a particular combination of different machines. In cases where the work must go successively to two or more machines in the department the machines should be so arranged that those machines which are to perform the earlier operations should be placed near the point where the work enters the room. If otherwise there will be much confusion and loss of time in carrying the work back and forth. This will produce delays and lower the percentage of efficiency of the department. When such a condition exists in several departments it will be quite impossible to keep up a reasonable standard of general efficiency of the plant. All these and an endless variety of other conditions will confront the mechanical engineering department whose wise and successful solutions will demand the best efforts of that force.

Tenth. Planning the arrangement of the different departments. What has been explained in the preceding paragraph applies with equal force in relation to this work, but is carried further into the details of the manufacturing problems involved. In the former case we discussed the relative location of the various machines. Now we are to consider the relative locations of the various departments to contain these machines, always bearing in mind that the special requirements of the particular machines to be built, or product to be turned out, will govern or very materially effect all the details of the problem.

### Relation of Departments.

These requirements will be considered somewhat in detail, so as to more fully explain their scope. We must first consider the relative extent of floor space to accommodate the necessary machines and workmen for the manufacturing operations. We readily see that to assign the proper amount of floor space to a department we must know the kind, and the number of each kind of machines that are to be installed. To ascertain this fact we must know what class, kind and number of machine operations it is proposed to have done in the particular departments under discussion. This brings us back to the plan which the mechanical engineering department should previously have worked out for the manufacture of the product in all its details.

1. Determining the work to be done.
2. Determining the machines and the men necessary to do it.
3. Classifying the necessary operations and assigning each class, or closely related classes into groups and assigning them to departments.
4. Determining the kind and number of machines necessary.
5. Determining the space necessary to install these machines and to furnish sufficient space around them for the convenience of material to be handled and the men to handle it. These requirements must be worked out very carefully and in much detail, and will generally tax the ingenuity and ability of the best engineer.

Eleventh. Having determined the necessary equipment of machinery, and from these conclusions and the extent and relative positions of the departments into which they have been

grouped, it now becomes the duty of the engineers to determine the form and relative arrangement of the building or buildings to house these departments.

The problem is still further complicated by the form and condition of the site upon which the buildings are to be erected, the transportation facilities available and the surroundings, particularly as relates to streets or roads, or the necessity for laying out approaches to the plant. In the solution of these problems the advisory services of the civil engineer and the architect will often be necessary, yet in the main the responsibility, in so far as it relates to successful manufacturing, will be one largely involving the mechanical engineer and depending upon his ability and judgment for its proper solution.

In this connection it should not be forgotten that great care is necessary at this point. Mistakes in planning a machine operation or in locating a certain machine can be easily remedied, but a mistake in locating a building will stand as a lasting monument to the incompetency of the engineer, and prove a continual source of inefficiency and loss to the plant.

### The Power Problem.

Twelfth. Planning the system for the generation and transmission of power. The question of power is a very important one, not only as to the selection and installation, but as to the cost of generating power, as this is a continuous and daily expense. Again, as to the economy of the method of its transmission. This is a large initial cost, and the expense of maintenance in proper condition for efficient service is one constantly recurring and depends to a great extent upon the professional ability and good judgment of the mechanical engineer who has had charge of these important matters.

Ordinarily the question of power is confined to the use of steam, although the recent revival of the use of water power for the operation of turbines driving dynamos, which in turn furnish an economical power which may be transmitted to any convenient location, has received a great deal of professional attention and met with unusual success on account of its economy, both in the generation and transmission of power, while the maintenance charges have not been excessive. Wherever the facilities and conditions are favorable for the successful use of this system it usually has the preference.

If it has been decided that steam is the more available power, the fuel question must be investigated. There are several kinds of fuel, some of which may be more available and economical in one locality and some in another. Among these are anthracite and bituminous coal, wood, natural and producer gas, oil, gasoline, etc.

There are many other kinds of fuel used in localities where a by-product which must be disposed of is available, as on sugar plantations, where the refuse cane after passing through the crushing rolls and of no further use in the production of sugar, is used for fuel, under the name of "bogasse."

The available supply of water for steam purposes and for fire protection must also be considered, as an ample supply is a matter of much importance.

The system for the generation of power having been determined, the transmission system must be worked out.

### Selection of Power System.

There are two general classes or systems for the transmission of power, namely:

1. By shafting, gearing and belting.
2. By electricity.

Here we have several leading propositions that experience has proven to be actual facts, and which the engineer should not lose sight of. Prominent among them are these:

First.—Large and heavy machinery, as rolling mill rolls, sugar mill rolls and similar classes of work, in which cases the machinery is connected directly to the engine shaft.

Second.—In cases where the power is to be transmitted short distances and where it is practicable to place the engine or other source of power, at or near the center of the area over which power is to be distributed, the use of shafting, gearing or belts, or a combination of these three, will be the more economical and available means.

Third.—If the power is to be transmitted to points at a considerable distance, or over a large area, or to a number of isolated points, transmission by electricity will be the proper and most economical system.

To apply these principles in practice, it may be found advisable in the case of a large plant to place the power house at some distance from the principal buildings of the plant and convenient to the fuel supply, as, for instance, at a wharf upon a navigable river or lake where coal may be delivered from boats directly to the supply bins, from which it is drawn for use in the boilers. The economy of this arrangement will more than offset the expense of transmitting power by electricity to the various points where it is required.

Having decided upon what system the power shall be transmitted to the various manufacturing departments requiring it, there still remains the problems of supplying individual machines with such power as is necessary. Several quite well known and amply proven facts are to be considered as reliable guides in the consideration of these questions. Among the most prominent are these:

### Subdivision of Power.

First.—Large and comparatively isolated machines can be driven more economically by individual electric motors than in any other manner.

Second.—Groups of small or medium sized machines are very economically driven from a short line shaft which in turn is driven by an electric motor of sufficient capacity to drive the entire group of machines, which are belted from this shaft.

Third.—In cases where there are a large number of comparatively small machines a single electric motor may be used to drive all the machines in the department, by arranging two or more line shafts for the transmission of power to the different parts of the room. In such cases the motor should be placed as nearly as practicable in the center of the area to be covered by the power service.

These problems will offer to the mechanical engineering department an ample field for the exercise of engineering ability and accurate judgment of the best ways and means of accomplishing the results desired.

Thirteenth. Planning an efficient and economical system of transportation. This system must be conceived on broad lines and developed with a view to its adaptation to the wants of all classes and conditions existing in the plant for the prompt, efficient and economical moving of all raw material, work in progress and completed product, everything that is to be moved within the plant, whether on the ground level or upon several floors, and also by elevators, cranes, hoists, etc., in vertical directions. Consequently this system will include yard tracks, shop tracks, hand trucks, traveling cranes in yards and shops, elevators, hoists, overhead trolleys and all similar appliances for handling and transporting all kinds of material in all parts of the plant.

To plan such an extensive and complicated system so that all its several parts, and its parts in all departments of the plant, will operate promptly, effi-

ciently and economically, will require a thorough understanding of the many and diversified requirements, and a thorough study of, not only transportation problems per se, but manufacturing problems as well. The transportation plans must be in harmony with and efficiently supplement the plans for manufacturing operations, in order to insure the success of the latter, since if material cannot be moved promptly, efficient machine operations cannot be conducted.

**Transportation and Costs.**

The transportation system must reach every machine in the manufacturing departments so that material and work in progress may be delivered directly to each machine, and promptly removed from it when the machine has performed its allotted work, so as to give place to other work which is constantly arriving; and to carry the work that has just been machined forward to the next machine (whether in this or another department), that is, to perform the next operation upon it. By a proper arrangement of machines and a proper sequence of machine operations this regular succession of work may be continually maintained, and the work moved constantly in one direction, always forward and toward the goal of completion.

If this result is realized it is easy to see that the costs of transportation will be reduced to a minimum, since there will be no need of switches and double tracks for returning cars, the number of cars will be reduced to the least possible number, and there will be no unnecessary men employed in the work. Every operation will be an effective step forward and performed with the least possible expense for effective work.

Fourteenth. Cost accounting. The development of the work of the mechanical engineer having led him into a critical and analytical study of the subject of the manufacturing methods and systems for planning machine operations, making time studies, time schedules and the transfer and tracing of orders and work through the different departments, it is but natural that he should give some study to the costs of these operations. The natural tendency of the engineer to analyze conditions and deduce facts led him still farther in this work until he has covered the entire range of the sources of manufacturing expense from the inception of these enterprises to the shipping of the completed product. And he has done this in a manner more complete and accurate than has been previously done by the best accountants who depended upon clerical skill alone, and without a knowledge of mechanical operations from a practical point of view. This development of the engineer's work has much extended his labor and influence and calls for the exercise of much sound and discriminating judgment and ability.

**The Showing Conclusive.**

From the foregoing it must appear that the work of the mechanical engineer has been greatly developed and broadened and that new fields for his efforts have been opened to him so that there is ample scope for the highest ability of the most ambitious man in directions of great practical value and usefulness.

# MODERN STEEL CAISSONS

## Their Development and Application in Sub-Aqueous Work for Various Purposes

By J. F. Springer.

When one carries iron and steel construction below the surface, whether on the land or water, he is at once confronted with the question of corrosion. In so far as that construction is of a temporary character, this may be disregarded. But when it is proposed to use materials in permanent works, then the question becomes a very serious one. However, the opinion seems to be pretty well founded that if the concurrent action of water and atmospheric oxygen can be prevented, corrosion will not take place or will proceed at quite a slow rate and engineers now seek to exclude the air or the water.

But so logical was the use of iron for the service of affording a retaining wall on the water front that such structures as that Blackwall, London, described in the Iron Trade Review for Sept. 30, 1909, page 577, in the series of articles on The Modern Steel Sheet Pile, were early constructed. Of this wharf, W. R. Kinipple, an expert on subaqueous work, said in 1890 that, although it was 55 years old, its condition was then good. The material here was cast iron, the water certainly was brackish, and being in a tidal stream, the exposure was variable. It is said that the low price of iron at the time, £7 per ton delivered, was probably largely responsible for its use at this wharf. But, whatever the logic of price then, the same is true today; iron and steel afford low-priced construction and further, the celerity with which actual installation can be carried out frequently becomes a large economic factor. So that, remembering that the price of wood is continually on the advance, we are not to be surprised that the demand for iron and steel for underground and under-water construction should now be rather insistent. In fact, the use of these materials may be regarded as marking an advance in certain lines of engineering practice. In illustration of this may be taken the steel caissons employed in the pier construction for the railway bridge for the Grand Trunk Pacific R. R., over the Kaministiquia River on the north shore of Lake Superior. At low water the depth reaches a maximum of about 20 feet. Beneath the water on the north side is a layer of river silt overlying a stratum of firm blue clay of perhaps 35 feet in thickness. On the south side, the clay is somewhat thicker. Beneath this impervious stratum is a comparatively thin layer of gravel overlying the bed-rock. The gravel lying thus between the rock and the impervious clay was found to contain water under sufficient lead to cause it to rise several feet above the level of the river when suitably confined. The piers were to be sunk to bed-rock. The largest, with a diameter of about 31 feet, would be founded about 60 feet below the river level; the other two, each 15 feet in diameter, would rest at a level about 3 feet short of this.

These piers were constructed of concrete laid in caissons of steel. The plates were, according to the plans, ½-inch in thickness, with double riveted vertical and single riveted horizontal seams, with ¾-inch rivets.

The large pier forms the support for the pivoting of the main section of the bridge. To place its caisson in position wooden false-work was constructed which consisted, in part, of two rings of piles, both encircling the site, with 20 piles in each ring, radially arranged in pairs, corresponding piles being about 8 feet apart. The inner ring had a diameter of about 37 feet, so that the radial distance to the

pier would be about 3 feet. The piles were cut off about 8 feet above the water and each pair connected by a capping timber which projected inwardly about 2 feet within the position of the perimeter of the steel shell. The 40 piles were in addition securely braced and tied so as to provide a very firm falsework made necessary by a current varying from 3 to 6 miles per hour. A floor was laid and on this a circular track upon which was mounted a derrick car which provided a means of handling moderate weights.

### Sinking the Caisson.

The method adopted here was to assemble the sheets of the caisson at the exact site. The derrick would pick up a sheet and bring it to the point desired where it would be held while being temporarily bolted to "hook plates." Such a plate was connected to two hanger rods which worked in a casting secured to the inner end of a cap timber. The hanger rods could be operated vertically and by means of the arrangement described, the caisson plates could be lowered to the precise level desired, when riveting could be done. It is said, by H. L. Wiley, in his account of the work, that the time occupied in bringing the plates from storage, swinging them into position for bolting, and bolting them onto the hook plates averaged about 15 minutes per plate. Each plate weighed about 1,100 pounds and 10 were required for a single course. Thus 2½ hours were, apparently, required to get a course in position for riveting. When five courses of the caisson were riveted in place and the structure had descended to the bottom of the river, its own weight was found sufficient to secure a penetration of about one foot and by the use of a 2-inch water jet an additional penetration of about one foot was obtained.

The hanger rods were arranged in pairs, corresponding to the capping timbers, one within the shell and one outside. This outside rod was now bolted to the nearest pile, to enable the projecting inner ends of the capping timber to be used as seats for twenty jacks, operating downward, which were next brought into action, in connection with a water jet, to force the caisson down. In this way, about 5 feet of additional penetration was secured. The shell was now well down into the clay, so that it was possible to pump it clear and a system of timber bracing was put in as the pumping proceeded. But a few days after the unwatering of the caisson, the hydraulic pressure from the gravel below—unresisted now by an 18 or 20-foot column of water—succeeded in forcing up the clay floor. This is perhaps not so surprising, if we remember that the 36 feet or so of soil were opposed by a head of about 60 feet of water. The hole was closed up and the shell unwatered again, whereupon the floor was forced up again, at a different spot. An attempt was then made to secure further penetration without unwatering, about 175 tons of steel rails were added to the weight of the shell and with the assistance of the jacks, a penetration of about 5 feet was added. The total penetration now amounted to but 12 feet and bed rock was still about 30 feet distant. An attempt to pump out the water was unsuccessful and a different procedure was adopted. The inner ends of the capping timbers were cut away and about 10 feet added to the height of the caisson. By arranging timbers across the upper opening, a means was found for supporting a floor inside the shell about a foot above the level of the water. An octagonal form was constructed within so that a course of concrete might be laid, circular on its outer edge and octagonal within. The aperture thus left at the center permitted the use of an orange peel bucket, acting as a dredge. This was operated by a derrick located on a fender crib which had been constructed upstream from the falsework of the pier. By continuing the inner form as well as the outer shell, upward the weight of the concrete could be continuously increased. The action of the grab bucket was carried on at the same time and it was found that in this way the caisson could be sunk without unwatering and penetration proceed until the rock was reached when the floor was cleaned and a bed of concrete, 7 feet thick, was laid, which successfully cut off the flow of water and allowed the wood bracing to be taken out and concrete filled in Pudding stones were used on a part of the concrete fill, which probably reduced the cost somewhat.

### Steel Bracing Suggested.

It would seem that the experience gained here might be serviceable. The ½-inch steel plate formed an admirable cutting edge and is probably largely responsible for the success obtained by the use of the grab bucket operating below water. It would seem that a steel bracing might advantageously be used to maintain the form of the shell. It would undoubtedly take up less room, and so permit a more effective operation of the grab bucket and it could readily be so designed as to permit of easy collapse and removal.

The two smaller piers of 15-foot diameter serve as the southern support for the bridge. These were placed about 18 feet between centers and in line with the flow of the river. The sinking of the two steel caissons seems to have occasioned no real difficulty. It was found possible to pump them out and thus accomplish a large part of the excavation in the usual way.

Assuming that these shells were fabricated from ½-inch plates, we may calculate the weight of the two thus. The large caisson consisted of 13 courses, each of which weighed about 5½ short tons, so that its total weight amounted to about 71½ tons. As this caisson was 31 feet in diameter and each of the smaller ones 15 feet, and as the latter were also about 5 per cent shorter, we obtain for the weight of one 32.7 tons. We have, then, a total of about 137 tons of sheet metal consumed as molds for concrete.

### Australian Double-Walled Caisson.

As the season was somewhat advanced at the time special precautions were taken to prevent freezing of the concrete. In the case of the large pier, the sand and gravel were heated. Heaters were improvised from 36-inch cast iron pipe and wood used as fuel and as this was plentiful, the expense of warming the sand and gravel averaged about $1.00 per cubic yard of concrete. Part of the concreting of this pier was carried on after ice had formed on the river. The pudding stones were preheated by submerging them in hot water. With all the piers, apparently, the concrete, where exposed, was kept from freezing by the use of a jet of live steam introduced into the caisson under a suitable covering.

The skin friction is calculated to have varied between 275 and 320 pounds per square foot. These figures are net, the resistance to the cutting edge, laps and rivet heads having been deducted.

This is a good example of construction of caissons on the actual site. The plates were punched, and bent to their proper curvatures at the shop. It was found entirely practicable to rivet with the holes as punched.

The work just described is interesting on account of the difficulties encountered—the severity of the weather, the strong upward pressure of water in the underlying gravel and the considerable depth reached by the main caisson. While the depth is by no means the most extreme on record for open caisson work.* Still it seems to be about the usual limit.

In the building of the Pyrmont Bridge at Sydney, Australia, a metallic caisson built of iron plates was sunk to nearly the same depth for the purpose of constructing the pivot pier. This caisson had a double wall, the annular space being 5 feet in width. The outer shells, 42 feet in diameter, was cylindrical from top to bottom. The inner shell was also cylindrical except that near the bottom it

*The lower edge of the wooden caisson for the pivot pier of the St. Louis Southwestern Railway Co.'s bridge over the Red River, near Shreveport, La., penetrated through about 65 feet of earth to a point about 90 feet below the usual level of the river.

was flared out to meet the outer shell and thus form a cutting edge and the space between the two shells was filled with basalt concrete. The interior of the caisson was mostly filled with rubble and a sandstone concrete. Mr. P. Allan, the designer of the bridge and actively engaged in its construction, states in his description of the work that the first section, 50 tons in weight, was assembled over the site. A square frame of timber was used for this purpose, which held the caisson section suspended by means of wire ropes from an overhead support. By lowering on the ropes, the section was floated. It drew 7¼ feet of water. Other sections were now added and concrete deposited in the annular space between the shells. As the concrete was placed, it was found that a vertical foot of it increased the draft by 2 feet, 1 inch, showing that the specific gravity of the concrete was in the neighborhood of 2. Wooden guides bore against the outer wall of the caisson and by means of wedges placed between these guides and the piles of the platform used in the construction, the great iron and concrete shell was gotten into correct position just before the soil at the bottom of the river was reached. Below the water, there were a 3-foot layer of mud and a 25-foot stratum of arenaceous clay and after penetrating these, the foot of the caisson would reach rock. However, the surface of this rock was, by no means, level; there was, in fact, a variation of about 8 feet within the 42-foot circle of the site. In penetrating the earthern strata, no difficulty arose in maintaining the caisson vertical. Four draft scales were painted on the inner face and these enabled the first beginning of any deviation from the vertical to be detected promptly. The

### Stopping a Leak.

excavation was accomplished by means of a bucket dredge carried by a floating crane. It was found that in excavating below the level of the caisson's cutting edge it was ordinarily unnecessary to work up close to the wall as the weight, and form of the cutting edge, pressed the material down into the working "well." As before mentioned, the rock surface was not level and accordingly, on the low side a quantity of clay was left. Upon unwatering, the caisson was found to have tilted 11 inches. Rock was removed on the high side and a settlement of 2 feet accomplished in 2 days. At this stage, the pressure of the water was sufficient to enable it to force an entrance and the caisson filled in 20 minutes. Mr. Allan believes that the "blow," which it was assumed developed from two small leaks, could have been avoided by the use of clay, had some been on hand. It had been expected that it might be necessary to use divers in excavating and to put a bottom layer of concrete in position under water, but as it seemed desirable to found the pier in the dry, the rock was cut away by means of "jumpers," a considerable bank of clay having been built up around the bottom of the caisson on the outside, caisson was brought back gradually towards the vertical. The deviation, when at last it came to rest, was 2¼ inches. There were a small number of places where the cutting edge had no bearing on the rock and these were cleaned with a hydraulic jet and a fine rich basalt concrete used to fill up the space. This concrete in bags was placed by divers. Further a wall of concrete in bags four feet high was constructed round on the inside of the caisson at a short distance inwards from the cutting edge and the space between this ring and the cutting edge filled in with loose concrete. A second ring of bags of sand but of smaller diameter was also constructed and the space between the two rings filled with concrete. All this work was done in about 50 feet of water. After the lapse of 9 days, the caisson was unwatered in 12 hours. Several small leaks were cared for, the wall of sand removed and concreting begun in earnest. For 12 feet, the concrete was of the sandstone variety; above this a rubble concrete was used until the top was reached. The "plums" or "pudding stones" weighed up to 3 tons each. The total time occupied in sinking the caisson was 9 months, one-half of which was taken up in securing the settlement through the final 6 feet.

FIG. 1.

### Caissons for Foundation Piers.

As before noted, the material used in forming the walls of the caisson was wrought iron. This was used in plates having a thickness of ½ to 5-16 inch. The two shells were held together by means of angle bar bracing. Upon the inside the plates were lapped "in and out" at the horizontal joints and cup headed rivets used. The upper half of the outer shell was constructed in the same way, but in the lower half the horizontal joints were butted and counter-sunk riveting employed. All vertical seams were butt joints and were made with cup headed rivets. The total weight of metal used is not precisely known by the writer but it was probably 100 or more tons and this metal forms part of the permanent construction. It is not very clear why wrought iron was selected. The water is salt and the exterior is, of course, exposed, but that would not seem to account for a wrought iron shell embedded in the mass of the concrete pier.

At Baltimore many steel caissons were used in placing the concrete piers which were used to support the superstructure of three of the new municipal docks and of a masonry bulkhead wall. The conditions here were somewhat different from those of the Grand Trunk bridge in Canada. There was no difficulty connected with the presence of an underlying hydraulic pressure which of course, simplified matters and further, it was not difficult to get a working position from

which to deal with the sinking operation. The caissons had an oblong cross-section rounded at each end, 10 feet long by 3 feet wide. In height, the main body was 27 feet. Such a caisson contains about 1 cubic yard of concrete for every foot of height. The caissons are of steel plates reinforced by angle bars, each weighing about 7 short tons and as 440 were employed, the total weight of steel amounted to about 3,080 tons. The system of caissons is to be regarded as merely temporary construction as their principal office was to provide a mold for the placing of the concrete piers.

### The Methods of Sinking.

To sink these caissons the practice was to begin driving by pumping out the mud from the interior and allowing the shell to penetrate as far as it would by its own weight. A heavy cap surmounted by a pile driving device was then placed in position on top and there was thus added a weight equal to about one-half that of the caisson itself. The steam hammer, weighing about 4,500 pounds and striking 40 blows of 30-inch stroke per minute was then operated in conjunction with the pump. The rate of penetration, of course, varied with subsurface conditions; at times it would amount to no more than 6 inches per hour, at others it would run up to 2½ or 3 feet per hour. When the driving became too difficult, the hammer was stopped and a hydraulic jet used in connection with the pump to remove the soil for perhaps a foot or more beneath the bottom of the caisson when the operation of the hammer would be resumed. Sometimes, it was found necessary to employ divers in the excavation. When the shell finally reached its footing in a stratum of course gravel underlying mud, fine gravel and sand, the interior was cleaned out and filled with concrete. This was a 1:3:5 mixture, and was laid below water by means of a drop-bottom bucket. About 12,000 cubic yards of concrete were employed in casting these piers.

In Fig. 1 we have a view of a caisson in place previous to being filled up with concrete. The position here is not an aqueous one. The courses are about 4 feet high. The vertical angle bars used for uniting thetwo plates of the course, are 3 x 3 inches. The transverse angles are, presumably, of the same size. A horizontal angle is added to reinforce the sheets in the center. If we assume that 30 per cent of the weight of the completed caisson is represented by angles, rivets, etc., we have for the (approximately) 634 square feet of plate surface a weight of 9,800 pounds and consequently, a weight per square foot of about 15½ pounds, or a thickness of ⅜ inch. In Fig. 2 we have a view of a caisson during the operation of sinking. The 2,500-pound cap (including guides) may readily be distinguished, as well as the steam hammer.

It will be noticed that the question of corrosion plays no part. Whether the caisson disintegrates or not is a small matter. Is is left in place because it cannot well be removed. It would seem quite possible, however, to fabricate it with a smooth surface on the interior, the angle bars being placed outside. If this could be done in such a way as to permit of collapse, then it would seem quite feasible to remove the shell after it has performed its service as a mold.

Back in the eighties it was learned that a bell form for the exterior of the bottom of the caisson was an incorrect design. This lesson was taught by the experience in founding one of the piers for the Hawkesbury Railway bridge in Australia. The caisson employed was of metal of an oblong form of cross-section rounded at both ends. The major diameter of this somewhat elliptical form was 48 feet and the minor 20 feet. Within, three cylindrical, wrought-iron working tubes were arranged. Steel struts of tees and angles united them to each other and the outer shell. At the bottom, the outer shell was splayed out at the slight taper 1 in 10 to form a cutting edge of 50 x 22 feet. The tubes were likewise expanded at the bottom, being thus united into each other and the outer shell. This caisson penetrated to the very considerable depth of 144 feet below high water of spring tides and four other piers exceeded this one in depth. But with none of the others was so much trouble experienced. In fact, the sinking of this caisson can scarcely be regarded as successful, its wandering from its designed position having been considerable. The caissons were built near by and fitted with a false bottom, which enabled them to be floated to position. Sinking then proceeded by loading

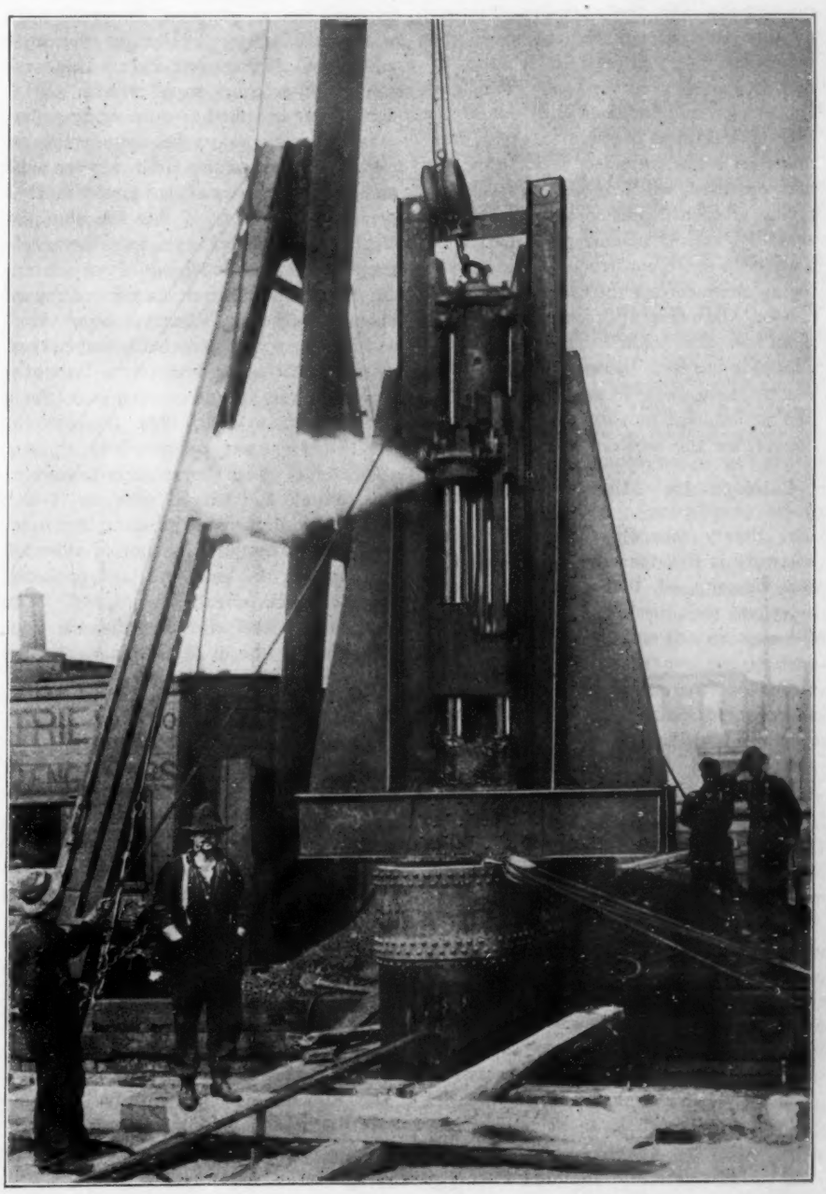


FIG. 2

with concrete and by dredging through the wrought iron tubes. As the caisson sunk, its height was added to by building up at the top. With regard to the particular caisson already referred to, 22 months elapsed before it had reached the 144-foot level. Actual penetration of the soil had not much more than begun when it was noticed that there was a horizontal drifting in the direction of the eastern of the two rounded ends. It was at first sought to give it a westerly deflection by excavating at the eastern end in advance of the other. This plan proving ineffective it was then sought to correct matters by dredging on the outside and dumping the material at the eastern end but without success. When the penetration had amounted to 75 feet, the easterly displacement still amounted to 5 feet at the bottom and 3 feet at the top. An 18-inch recovery was accomplished however at about this stage. When the western edge reached the sand, the increased resistance on that side brought about a righting movement, but this really effected a further displacement at the top. Three grab buckets got caught when the foot of the caisson was at a depth of about a hundred feet below the water level. One was not recovered, which is not surprising, as diving at such depths means an air pressure of about 45 pounds per square inch. Two cribs were constructed—one providing an abutment for the eastern end of the caisson, the other affording an anchorage point on the west. But this effort although assisted by excavation on the eastern side, was likewise unsuccessful, and an attempt to sink a supplementary caisson on the western side also failed.

### Caissons for Mississippi Bridge.

The theory regarding the drift to the eastward is that there was a difference in the viscosity of the mud on the two sides and thus, assuming that the mud on the western side was less stiff than on the eastern, we can readily see that on the stiffer side there would be a reduced area of resistance on account of the soil caving in more slowly. However this may be, the eastward drift is attributed to the bell form of the outer shell.

It will be seen from this example that very deep sinking by the open air method may be attended by unforeseen occurrences impossible of correction. In the system of pneumatic procedure, such difficulties are also conceivable. But it is also conceivable that with men at the actual point of excavation more effective means of correction could be adopted than otherwise would be the case. However, it is not asserted that pneumatic caissons could have been sunk during the eighties, or can now be sunk, to such depths as 146 feet, 146 2-3 feet, 155 feet and 162 feet. These are the founding levels of four of the piers of the Hawkesbury Bridge. But a depth of nearly 120 feet has been reached successfully, as will appear later.

Somewhat similar to the steel caissons used at Baltimore were those employed by The Foundation Company of New York in founding 10 piers of the Clinton bridge over the Mississippi river built by the C. & N. W. Railway. These caissons were steel cylinders about 10 feet diameter, 30 feet long and formed of ⅜-inch plates in six 5-foot sections and so were quite a little larger than the Baltimore oblong caissons. The piers, incased by these shells are in pairs and are located at a point where the bridge crosses a slough. Each pair is calculated to carry about 640 tons. The depth of water varies from nothing to 5 or 6 feet. There are a few feet of muck underlaid by a stratum of sand the thickness of which is unknown. The cylinders were sunk by the use of water jets assisted by a superimposed load of pig iron. A trestle-work was erected along the line of the work and a track laid upon it and on this track a locomotive crane supplied with a grab bucket was operated as a dredging apparatus. In this way the cylinders were excavated from within as they were sunk and the sinking was continued until a penetration of 12 to 15 feet was obtained. Within these steel cylinders there are from 15 to 18 wood piles of an average length of about 28 feet, cut off and topped about 2 feet below the low water level, so that they are perpetually submerged. As about 320 short tons is the load of a single cylinder, the piles must carry from 21 to 28 tons each. The piles in the the cylinder itself concreted to or near the cylinder itself concreted in to or near the summit and capped with an 18-inch coping of white sandstone. The piles were driven by the assistance of a derrick car carrying the leads, etc., and operating on the track already mentioned. The amount of steel consumed in the construction of these 20 Cushing cylinders was nearly 150 tons.

### The Pneumatic Caisson.

In the preceding cases, we have been concerned entirely with open caissons. We have considered a caisson of moderate size, penetrating to a very considerable depth under severe conditions, a caisson of considerable diameter also penetrating to a low level, and finally a group of many caissons where the conditions were moderate. All had this in common—they were of metal and represented recent and up-to-date methods.

The open air procedure is frequently attended with a great deal of uncertainty. The difficulties cannot always be sufficiently foreseen, although modern methods of drilling exploratory holes supply very valuable data. Thus, in the case of the caisson for the pivot pier over the Kaministiquia river, it seems to have been known in advance that water under a greater head than could be accounted for by the local level of the river was present beneath the thick stratum of clay. As the event proved, this was no insurmountable obstacle, but if in addition a large boulder had been encountered, it is possible that the open caisson would have been found ineffective.

The pneumatic caisson affords a procedure which has demonstrated itself as applicable to practically all conditions. This certainty of success has made it a strong favorite with engineers, although the expense is one great objection to it, consequently they frequently accept the risks of the open air method.

The theory of the pneumatic caisson is of course that an air pressure equal or slightly superior to that due to the head of water above the foot of the caisson will exclude the water and keep the interior dry, and this it does perfectly.

### Advantages of Pneumatic Method.

The men who work in the caisson must work in the compressed air. At a depth of 34 feet below the hydraulic level, the air is just twice as dense as on the surface; at 68 feet, it is three times as dense; at 102 feet, four times; and so on. It will readily be granted that human endurance sets a limit to the depth of penetration of pneumatic caisson, that is to say, a limit is set, if no additional device is brought in.

This procedure has the advantages that whether it is water alone that is penetrated or water-bearing strata, the working chamber can be kept dry so that (1) the workmen see what they are doing; (2) the engineer has opportunity to examine the footing surface; and (3) the concrete or other masonry may be placed in position in the dry, and to these must be added the opportunity to deal advantageously with builders and other obstructions as they are met. But it is often very expensive. Thus in certain deep work in Ireland the excavation at times cost in the neighborhood of $200 per cubic yard. But over against the possibility of great cost is to be set the certainty of success. Let us now consider some of the notable recent examples of the compressed air procedure.

At the Broomielaw, Scotland, the Caledonian Railway crosses the Clyde upon a new bridge whose piers were founded within steel caissons. The river is, at this point, about 500 to 600 feet broad. Viewed from the bank, the bridge is seen to have two supports, or piers, rising from the river. Upon observing more closely, these piers are found to consist, each, of 5 columns of stone and brick, which are founded in rectangular steel caissons upon a footing of concrete.

Two caissons were employed for each pier.

Let us consider more closely a typical caisson. In the first place the working chamber, which forms the lowest part of the caisson, is a room with steel walls and steel roof. There is no bottom or floor. Three vertical shafts, each 3½ feet in diameter, rise from the roof. These open into the working chamber at their lowest point and project into the open air at the top and constitute the means of communication between the working chamber and the outside. The workmen pass in and out through these; the spoil from the excavation passes through them. Enveloping these shafts the steel walls of the working chamber are continued upwards for some distance. This caisson then is simply a huge steel box without bottom or top, but with a horizontal partition in it dividing the interior into a lower and an upper story. Three tubes, or shafts, connect the lower story with the surface. In the lower compartment, or working chamber, which has a height of 8 feet, the men, or "sand hogs," as they are called, carry on the excavation. The roof of this chamber has been made exceptionally strong as it must bear a heavy load. The caissons were built at the point of use. Previously a wooden staging had been thrown across the river for construction purposes and at the points where the caissons were to be lowered, openings had been left.

### Operation of the Air Lock.

At a suitable stage, the partially completed caisson was hung to steel girders supported on trestles erected at each side of the opening in the falsework, that is to say, a pair of riveted steel plate girders were arranged close together and supported parallel with the axis of the bridge in a position above the caisson and near each end. Four saddles were placed in such position, one at each end of a pair of girders, that they permitted the vertical operation of four rods by means of hydraulic jacks and upon these rods the caisson was hung and then lowered until the water was reached. A quantity of concrete was now laid on top of the roof of the working chamber, the caisson was detached from its overhead support and permitted to find its level in the water, while girders fixed to the falsework controlled its horizontal position. More concrete was now added and this procedure continued until the caisson came to rest on the river bed. The shafts had been closed, so that the tension of the contained air had to be overcome by the weight of concrete to permit the caisson to ground. Probably at this time the inside of the working chamber was partially occupied with water with the contained air at a higher tension than that outside. If the shafts were left open, not only would the water in the working chamber rise to a higher level, but it would rise to the level of the river surface, unless the conditions of the river bed were such that no additional water could enter. If the strata to be gone through are perfectly impervious, the contained water could be pumped out and the caisson sunk by open air methods, and if but a small quantity of water enters, the pumps may, perhaps, be relied on to keep the interior in condition, but if air compressed to a tension constantly equal to the hydrostatic pressure is supplied in sufficient amount, then the work chamber can be kept quite free of water irrespective of the permeability of the soil, therefore when the caisson had become well settled on the river bed, the air locks were added. The office of the air lock is quite analogous to that of the hydraulic lock on a canal. In the latter case, by the use of a lock-ful of water from the supply at the upper level a ship is enabled to make the passage between the two levels. So with an air lock. It is a device which by the use of a lock-ful of compressed air permits a person or load or empty bucket to pass to and fro between the working chamber and the external atmosphere. With the locks added and the compressed air turned on, the men were enabled to proceed with the excavation until the required level was reached. It will be understood that the compressed air plant must continue at work for two reasons—(1) to compensate for the loss of air occasioned every time the lock is used, and (2) to increase the pressure as penetration to lower levels advances.

### Building the Superstructure.

There is no necessity to wait until the final position of the caisson is reached before going on with the construction of the pier; in fact this superimposed weight is utilized to sink caissons, the skin friction being overcome by this means, but it will readily be understood that the procedure of adding weight necessitates a strong deck over the working chamber. There is a considerable advantage in being able to go ahead with the pier construction in advance of the foot of the caisson reaching its final level, which is, however, not necessarily peculiar to pneumatic operation. This advantage will be perceived when it is stated that, in the case of every caisson sunk in the river for this Clyde bridge, the side walls fall short, by several feet, of the depth of the river. To avoid the necessity of carrying these walls, forming a cofferdam, up further, all that was necessary was that when the upper edge of the caisson was about to sink below the surface of the river, the concrete and brickwork should have reached at least the same level and should be continually kept there as the sinking proceeded.

Now when the final level has at last been reached and the interior of the working chamber has been properly cleaned, and men and tools have been gotten out, the concrete filling may be put in. The side walls and deck of the caisson are both, ordinarily, left in. The shaft may be left in, or may be removed. We have now a composite pier reaching from the foundation level of the natural stratum up to the upper surface. In the case of the Clyde bridge, it consisted of concrete, steel, blue brick and granite.

### Cast Iron Also Employed.

The depth at which these piers have their footing is probably not a very low one, but in the case of the long railway viaduct crossing the River Barrow in southern Ireland a very considerable depth was found necessary; thus, several piers are founded at a level of about 100 feet below low water, in fact, the deepest footing was made at a depth of nearly 120 feet below high water. Such a head of water would produce a pressure of about 50 pounds per square inch, and in order that the men would not be compelled to endure a pressure of more than 45 pounds per square inch, ejectors worked under air pressure were employed to get rid of the water coming in beneath the bottom of the caisson. Special precautions were taken in connection with this bridge to reduce illness consequent upon the excessive pressures which consisted largely in reducing the length of each shift, enforcing slow passage when coming out of the air locks, providing warm refreshments, and insisting on the workmen, at all times, taking sufficient rest immediately upon coming out of the locks.

There are, in all, fifteen intermediate piers in this viaduct which has a total length of 2,131 feet between abutments and two caissons were sunk for each pier. It was found possible to do some open air excavation by means of grab buckets, but the pneumatic method was largely relied on and every one of the 30 caissons was founded under air pressure. The construction of the metal shells which encased the concrete shafts of a typical pier is as follows: The lower portion enclosing the working chamber has a diameter of 10 to 15 feet, which is reduced, conically, to a diameter of eight feet. The lower portion and the reduced diameter section

up to just below the river bottom, is constructed of steel rings. Above this point, cast iron rings are used. This upper portion—partly steel, partly iron—has a uniform diameter of 8 feet. The steel cylinders forming the base were riveted together at the point where they were to be sunk, wooden falsework having been built for construction purposes. Concrete was now employed to complete the working chamber and to form a hollow column of such height that when the lowest steel ring should come to rest on the river bottom, the concrete would project above the water level. The vertical opening left was 3.67 feet in diameter, sufficient to afford a passage for men and material. By the use of hydraulic jacks the steel and concrete structure was then lowered upon the river bottom. The addition to the metallic rings and the lining of concrete was carried on as the foot of the caisson penetrated to its resting place. It was upon this job that the expensive excavation, already referred to, was done.

### Pneumatic Caissons of Large Size.

That the employment of cast iron rings is attended with risk may be learned from the experience gained in the construction of the viaduct crossing the River Suir in Ireland. The process used at the River Barrow was also employed here; that is, cylinders formed of steel rings for the portion of the pier shafts extending from the foot to a little below the river bottom were replaced by cast iron from this point upwards. When one of the cylinders of this viaduct had reached a level of 70 feet below the river bottom and the pressure of the compressed air was at 32 pounds, the ring just above ground burst, resulting in the death of one of the workmen. The tensile strain on the cast iron is stated to have been 1,100 pounds per square inch, and as this seemed to allow a sufficient margin of safety, an examination was made. Test pieces are stated to have shown that the iron was equal to the specified requirements, no flaws were discovered and in fact, the failure was not accounted for and is considered as a proof that cast iron is not to be relied on for such purposes.

Under the historic Thames at London there are perhaps a dozen tunnels. What is known as the Rotherhithe tunnel has recently been constructed. The river portion is not so long as the New York sub-aqueous tunnels, being about 3,690 feet long, but it has the very considerable diameter of 30 feet. In the constructive work attendant upon this work—including the land approaches—four steel shafts were sunk, of which the two on opposite banks of the river are of especial interest as having involved the use of pneumatic caissons, the other two were sunk by open air methods. All these caissons were cylindrical with double walls of steel plate 5 feet apart. At the bottom the inner shell was flared out to meet the outer one and thus form a cutting edge; the two shells are of course secured to each other by suitable struts. The outer surface of the caisson was perfectly free from all irregularities or projections except the lap joints where the various sections met. The annular space between the shells was filled with concrete. We are, of course, not to suppose that such a structure was completed and then sunk, but that the two operations went on simultaneously. The roof of the working chamber in the pneumatic caissons consisted of a very heavy airtight deck. The girders which formed the framework were of great depth—8½ feet, which was, perhaps, not excessive in view of the diameter of 50 feet inside the caisson. These plate girders were six in number, arranged in two sets of three each, the one set being at right angles to the other and small subsidiary girders were fitted in the spaces between. The surface of the floor consisted of buckled plates. Above the airtight deck of the working chamber, circular openings were arranged in the walls of the caissons for the tunnel. These openings were 32 feet in diameter and were circumferentially lined by heavy steel plating and had, of course, to be closed during the process of sinking. Above the openings in the wall a second, but temporary, airtight floor was constructed.

### Effect of Pressure on Sinking.

In excavating, the central portion was first dealt with leaving a shelf upon which the cutting edge rested and the width of which was variable, being in fact a matter of judgment at the time and dependent upon the material being penetrated. Advantage was taken of the absences of the men from the working compartment to lower the air-pressure somewhat, which would be equivalent to adding weight to the caisson and usually the structure would sink a short distance, when the air pressure could be brought back again. It might b ethought, perhaps, that the reduction of the pressure a few pounds per square inch could have no great effect, but if we consider this a moment it will be evident that the air pressure is, ordinarily, assisting in the support of the structure and this support is exerted over an area equivalent to a diameter of 60 feet, and which amounts to 407,000 square inches. The reduction of a single pound in the pressure, is consequently equivalent to the addition of over 200 tons weight, and it is easily seen, then, that the reduction of several pounds would have substantial effects. It is said that in certain pneumatic caisson work at New York very considerable reductions in pressure were made even with the men in the working chamber. Of course, such an expedient would only be temporary, as the pressure was really required to overcome the hydrostatic head.

### The Moran Air Lock.

In using the pneumatic method, we have to overcome not only the skin friction between the surface of the caisson and the soil, which may amount to a great deal and varies, of course, with the character of the strata penetrated, but there is a very considerable resistance to penetration due to the pressure of the air that excludes the water, and as we go down below the hydraulic level the pressure required to effect this exclusion constantly increases. As this pressure is exerted in all directions, upwards as well as downwards, and the resistance to penetration is that due to the total exposed area multiplied by the air pressure, which as has been shown, increases as the hydrostatic head. Thus in sinking such a caisson we must overcome with the weight of the caisson itself and its accessories, and with that of the load added, not only a skin friction that is becoming greater and greater, but also a constantly increasing upward thrust from the compressed air. In practice, it is often necessary to assist the augmenting load of concrete very considerably. To accomplish this extra loading with an economy of space, pig iron may be used, cast in such forms as to be convenient to handle. This may seem a trifling mater but it is not to be so regarded. In putting down 116 piers for the new municipal buildings in New York City, The Foundation Company are using upwards of $25,000 worth of such weights. Not only is that amount of capital tied up by this one item, but it cannot be entirely recovered, because to scrap the iron it must first be broken up. This, of course, means expense.

The air lock in general use in the United States is, fundamentally it seems, the invention of D. E. Moran, Vice-President of The Foundation Company. He has improved his original device, so that now the Moran air lock can be operated, so it is claimed, with despatch and safety. While despatch is by no means to be sought while the men are passing through, it is of high value in making disposition of the spail. By referring to Fig. 3, a view of this air lock will be seen in three different situations. Such a lock

is fitted to the upper end of the working shaft. This union is made airtight, of course. There are two horizontal doors, each of which may be swung downwards into a vertical position. The upper one of these closes the external entrance to the lock; the other a short distance below, when closed, completes a division of the total space subject to air pressure into two compartments. The upper compartment is quite small; the lower extends to the bottom of the working chamber. These doors are both closed as shown by the left hand view. There is, however, a tubular connection between the two compartments, as may be seen in all the views. There is a three-way cock in this connection by which the upper and lower compartments may be put in communication or the upper may be opened to the external air. The conditions disclosed in the left hand view represent the situation immediately precedent to opening the upper door for entrance. The air pressure in the lock chamber is already at normal, or will soon become so by the equalization taking place.

**Operation of the Moran Lock.**

As soon as the air pressure in the lock falls to that of the outside atmosphere, the upward pressure against the upper door will be removed and it may take the vertical position shown in the middle view. The empty bucket may now be introduced and by swinging this somewhat to the left, the door may again be closed. If now we turn the three-way cock to cut off the lock chamber's connection with the external air and establish it with the lower compartment, there will be an inrush of compressed air into the upper compartment, bringing the pressure there into equality with that below. The excess upward pressure against the lower door will now be removed, thus permitting the opening of it; which is the situation shown in the right hand view, and the bucket may be lowered. There is a vertical separation of the shaft below the lock into two passage-ways—one for the workmen, one for the material. This seeks to avoid the danger of men being struck by passing buckets. In passing out, the three operations are gone through in reverse order. Thus the right-hand view may represent the bucket ascending into the lock chamber where the same air pressure exists and as soon as the bucket is well into this chamber, the lower door may be closed and the cock turned and there will follow an equalization of pressure between the air in the lock chamber and the external atmosphere. This lock-ful of compressed air will be lost, but no more, as the connection of the lower compartment is now cut off. The upper door may now be opened and the bucket withdrawn as shown in the central view and if we now close the upper door, we have again the conditions represented in the left-hand view. It is sometimes necessary to adopt precautionary measures to prevent the workmen coming up from the heavy pressure of the working chamber from passing out of the lock too quickly. Thus, in building the foundations of the Clinton Bridge, where the pneumatic system was employed for part of the work, a regulating valve was employed. When the pressure was in the neighborhood of 35 pounds, corresponding to a depth of perhaps 75 feet below the water, the pressure of air in the lock chamber would not be allowed to fall to that of the outside air under 15 or 20 minutes and there was thus allowed some time for nature to readjust matters.

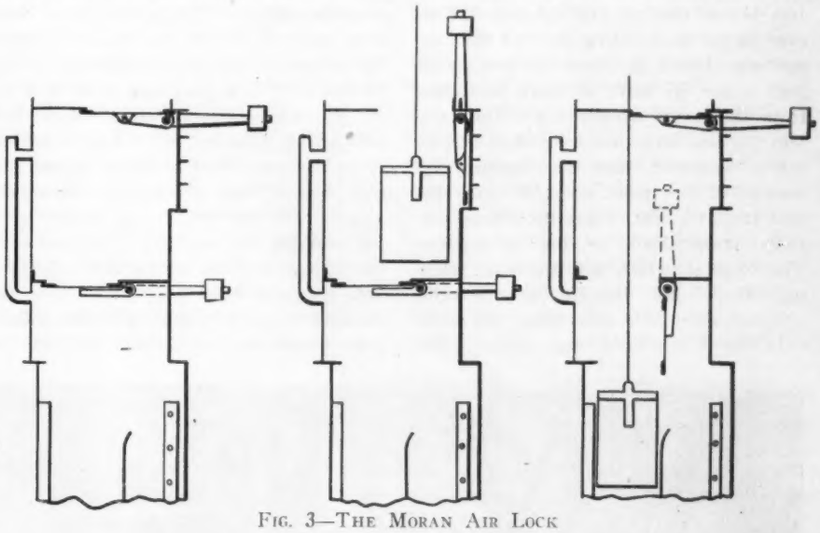


FIG. 3—THE MORAN AIR LOCK

We have already seen that the use of cast iron for cylinders in pneumatic work is attended with grave danger. With high pressures, a very slight and undiscoverable defect may be the cause of a failure of the wall of the shaft. Such a fracture, at or near a point where no sealing of the surrounding material would be affective in retaining the air, would mean a very prompt reduction of the pressure in the working chamber followed by the entrance of water and perhaps other material such as quicksand and the workmen might be very quickly overwhelmed. In a recent instance of pneumatic construction, a compromise between steel and iron was effected by the use of cast rings of a material composed of a mixture of iron and steel. It is said that the resulting composite metal had a tensile strength of 30,000 pounds per square inch.

This material was used for the pneumatic caisson for the lighthouse at the Elbow of Cross Ledge, located at an exposed point on a sand bar in Delaware Bay at nearly equal distances from the Delaware and Jersey shores. Beneath a depth of about 24 feet of water at low tide are strata of mud and sand to a depth of perhaps 40 feet underlaid again by a thick stratum of mud. The problem was to found a lighthouse deep enough in the sand to enable it to withstand the severity of the storms and yet not so deep as to expose it to subsidence. Knowing the general formation of the soil, the government proposed to build and sink a caisson of hour-glass form, having a diameter at top and bottom of 40 feet, and midway between the two, of 30 feet. The floor, which formed the roof of the working chamber, was arranged about 6½ feet above the bottom. At the center of this roof a cylindrical working shaft was

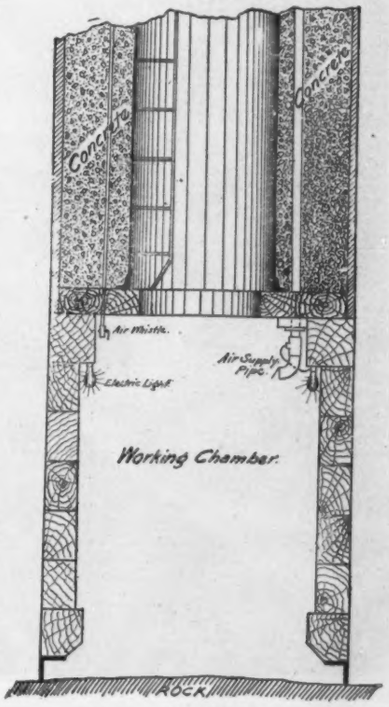



FIG. 4—SECTION OF TYPICAL CAISSON

arranged, having a diameter of 6 feet. The height of the caisson itself was about 55 feet; of the shaft, about 30 feet; the top of the shaft would thus be about 18½ feet below that of the caisson. However, as the final resting place of the caisson was found at about 40 feet below high water, its walls afforded protection from the water of the bay. The castings for this structure were shop erected before shipment, then disassembled and forwarded to a point about 46 miles distant from the site, where they were partially reassembled by the contractors. The whole structure, with the floor, working shaft and bracing arrangements weighed about 291 short tons, but when only about one-third was erected, this portion was launched. With a load of concrete, it weighed about 150 tons. Another third was now added to the height and a considerable quantity of concrete added. The whole affair was now about 22 feet in the water. Above the surface, it rose to the height of about 14 feet. It was proposed to float it to the site, which was eventually done, but with great difficulty, as it was found to be an obstinate kind of barge, giving the tugs a great deal of trouble. However, after severe exertion, it was at last gotten over the site and allowed to settle to the bottom with the ebbing tide and filled with water to keep it in place. The remainder of the iron work was then added. This weight was not deemed sufficient to hold the caisson in place when the water should be pumped out so inside platforms were built and loaded with crushed stone. The concreting of the caisson was then proceeded with, using the stone from the platforms for this purpose. When the load of concrete on the roof of the working chamber amounted to about 3,200 pounds per square foot, it was thought best to stop concreting and the pneumatic work was begun. However, some penetration had already been made by weight alone. When about 7 feet below the bottom of the bay some sand was found, but the sinking was continued until a depth of 92-3 feet was reached, which was about 40 feet below high water level. It was then a simple matter to concrete the whole structure to a finish. It is stated that rip-rap to the depth of 5 feet was placed over an area of 160 feet in diameter at the site to prevent scouring of the bar at this point.* Apparently, the purpose of the bell-like formation at the bottom of the caisson is for the purpose of securing a better anchorage; above, the expansion seems to serve the purpose of a protection against the waves.

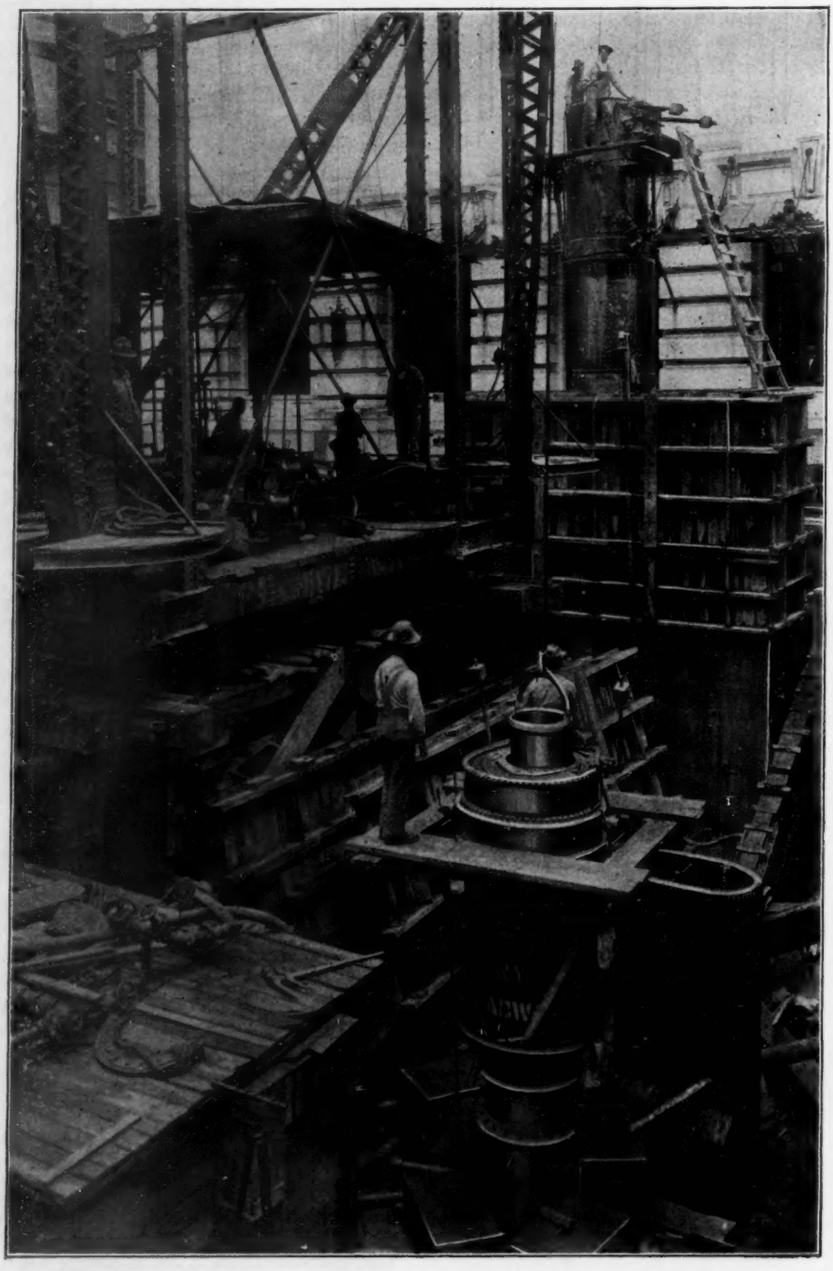


FIG. 5—EXAMPLES OF CAISSONS UNDER CONSTRUCTION AND SINKING

### Caissons in Foundation Work.

Foundation work for buildings is, at times, of the most exacting character; especially in New York City. The extreme height of some of the structures and the consequent imposition of tremendous loads is only one part of the problem, because this merely requires that piers be sunk to hard pan or bed rock. In fact, some very high buildings are erected on piles—the Park Row Building being a case in point. The chief difficulty in the lower end of Manhattan connects itself with the presence of water and when this is associated with sand, we have the great problem which confronts foundation engineers. The difficulty does not center itself upon securing penetration, but upon the preservation of the foundations of adjacent structures. If the water is removed in large quantities from the immediate site, this may at once entail a settlement of an adjacent foundation. It is this consideration, perhaps, more than any other which has brought the pneumatic caisson into such general use in the southern end of Manhattan. In fact, so necessary and extensive has the application to foundation problems in New York City been that during the past few years the procedure has been almost revolutionized. In order to get a clear idea of the improvements that have been introduced, let us for a moment consider the essential features of the ordinary methods. First, there is a working chamber open at the bottom and decked over above with the exception of a central opening; second, from this central opening a ver-

*Engineering Record.

tical shaft rising to the surface; third, the side walls of the working chamber are continued upwards to the surface, to form a cofferdam. The material of the caisson proper and of the cofferdams may be of wood or steel; the shaft will be of steel or some material which can be made air-tight when the air is under pressure. The concrete is first placed on the roof of the working chamber, within the cofferdam but outside the shaft. The upward prolongation of shaft wall, of the cofferdam and of the hollow cylinder of concrete resting on the roof of the working chamber proceeds somewhat together. When sinking to the final depths has been completed, concrete is laid in the working chamber and carried on up the shaft to the surface. There are thus two distinct bodies of concrete which are separated from each other by the wall of the shaft and the roof of the caisson. The roof is thought to be a serious matter, for, if it deteriorates, a settlement of one part of the composite pier is to be expected. But will it deteriorate? The pneumatic procedure is usually adopted because of the presence of water, and whether the roof be of wood or steel, the action of water at a considerable depth is ordinarily regarded as a preservative one. However that may be, in New York especially, the tendency has been to get rid of it altogether. This development has been pointed out by Dr. D. A. Usina. Quite recently, in the construction of the foundation piers for the tall building of the United States Express Co., there was put into practical effect the idea of eliminating the roof.

**Removing the Shaft Casing.**

The caissons proper consisted of rectangular boxes of heavy timbers with a temporary deck of wood constructed somewhat below the top. Across thetop, steel angle bars were laid. The wooden deck carried the steel shaft. Concrete was laid on this temporary deck and as this concrete enveloped the steel angle bars, they served the purpose of affording a support as the concrete was carried upward. The external vertical walls of concrete, being molded to the form and size of the caisson proper, formed an upward continuation of it and the external molds were mere temporary cofferdams and constituted no permanent part of the structure. In the way described, a substantial roof of concrete was obtained. Before converting the working chamber into a pneumatic caisson, the temporary wooden decking was removed and the concrete having become hard was sustained by the walls of the caisson. The angle bars may have assisted somewhat at first. As sinking continued the effect of skin friction and the upward thrust of the air would enter and, in fact, weights were needed to effect sinking. It will thus be seen that the roof is really only a temporary affair under old conditions as well as these newer ones. This instance was probably the first case of the actual elimination of the roof. It is said that the angle bars might have been so designed as to permit of their removal also.

The next step is the removal of the shaft casing. It might be thought that this shell need be nothing more than a center mold for the concrete, and could thus be used and removed in short sections. This is possible in regard to the outside shell, the cofferdam, as, if the concreting is carried on above the water level, and the new portion of the pair is not sunk into water bearing soil until hardening takes place, the shell has no duty to perform except that of a mold, but the shaft lining must connect the air lock and the working chamber until the sinking is completed and the air pressure is finally removed. This is its chief service. Because it is present, it may be used as the inner vertical mold of the concrete, but the cofferdam which forms the external mold of the same concrete need extend only from the upper surface of that concrete as already laid to any convenient height and as the upper surface of the concrete may be kept above the surface of the soil, the cofferdam construction may be only a question of a few feet. As the caisson sinks the concrete serves to exclude the adjacent soil and any water coming in from the side, that is, the concrete itself becomes the cofferdam.

FIG. 6—THE WORKING CHAMBER FOR A PNEUMATIC CAISSON

As just said, the steel shaft must connect the working chamber and the air lock. It might be thought that an air-tight connection between the lock and the hollow concrete cylinder would be sufficient, but we must not forget the ever present upward thrust of the compressed air. An air lock with a cross-section of 3¼ feet would be subjected to an upward pressure of one-fourth of 1.375 short tons, or 0.344 short tons, for every foot that the cutting edge of the caisson penetrates below the hydraulic level, so it will be seen that the air lock must be very strongly connected, or a serious accident may endanger the lives of the workmen below. A proposition was made to employ tie rods reaching from the air lock to near the foot of the whole structure and to imbed these in the concrete. By this method, it was proposed to eliminate the shaft lining. The first instances in practice where the shaft lining was not eliminated from the construction but removed after completion of the sinking operation apparently occurred in connection with the building of one of the Trinity Buildings (115 Broadway) and of the United States Realty Building. The shaft lining consisted of units of convenient length, which were each made in three sections having both vertical and transverse internal flanges to permit the bolting together of the parts of the unit and of the units themselves. One section would be made quite narrow with rungs placed in the vertical flanges forming a ladder. When the sinking was concluded, and the air pressure cut off, these units and their component parts could all be unbolted and collapsed. This general design has been found entirely practical. It was employed in sinking the foundation piers of the celebrated 41-story Singer building on lower Broadway where the footing level was 90 feet below the surface, and about 75 feet below the hydraulic level and has, in fact, become standard practice with The Foundation Company which sank the piers for the Singer building.

In Fig. 4 we have a sectional view of a typical pneumatic caisson, which has reached its final position with its cutting edge on the bed rock. Notice the heavy timbers of the working chamber. Sometimes the side walls have to be made excessively thick and the roof thicker yet; it is largely a question of the depth to be penetrated and the character of the soil. In the case shown in the figure, walls and roof are moderate. Above the caisson proper is the concrete surrounding the working shaft and enveloping this concrete is the cofferdam, which has been left in. The tube which conducts the air to the working chamber penetrates the concrete on the right. When the bottom has been properly cleaned off, and the sections of collapsible steel shafting have been removed, the working chamber and the shaft may be filled with concrete. If it is desired to tie the superstructure to the pier, it may be accomplished at this juncture—that is, before the final concreting. Thus in the case of the Singer building ten of the 30 piers were utilized in this manner. Steel rods were carried down nearly to the bottom and secured to suitable anchors.

It has recently been proposed not

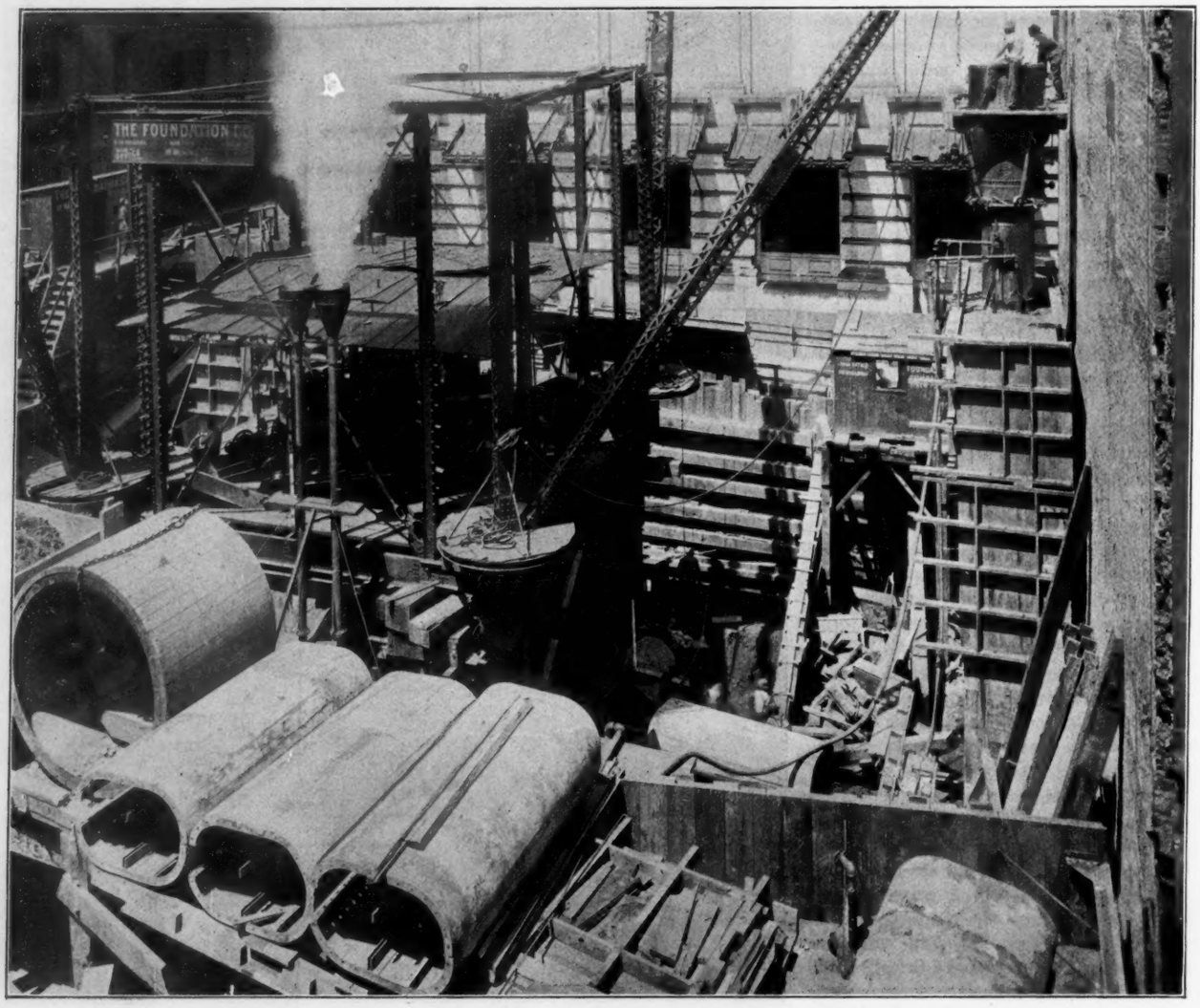



FIG. 7—ANOTHER VIEW OF CONSTRUCTION OF CONCRETE PIERS ABOUT STEEL AIR SHAFT. COLLAPSIBLE SHAFT SECTIONS IN FOREGROUND

merely to introduce vertical steel rods into the body of concrete piers, in which case they might merely become a reinforcement performing the function of keeping the concrete together, but to employ a true steel supporting column which may be designed so as to be capable of carying the entire load, or any part of it. In any case, it may be carried down to bed rock and obtain the same footing as the concrete itself. This is, perhaps, the coming system of construction, for although concrete has a high compressive resistance, it cannot be compared with steel. In these days when such structures as the towers of the Singer and Metropolitan buildings are not merely dreams but actualities, and still higher construction is conceived, it is not at all inconceivable that it may become impossible to place a sufficient area of concrete to support the superimposed weight. In such construction as the concrete pier enclosing the steel column, the concrete would have only a subordinate function; if the steel column carried the entire weight, then the concrete would merely be a protective wall enveloping the steel and guarding it against corrosion. This wall would perhaps continue to be made much thicker than this duty would require because of its function in connection with pneumatic penetration to bed rock.

The Singer building is one of the most notable constructions in New York. In that locality the water level is met about 15 feet below the curb and bed rock is about 75 feet lower. Above the curb, it rises to 41 stories, exclusive of a final 6 stories in which the plan area is insignificant. The main portion is only about 65 feet square, still, in spite of the difficulties arising out of the circumscribed area, 30 piers were put down to bed rock. In the views shown, the tremendous crowding can be readily seen. In Fig. 6 we have in plain view one of the heavy wooden caissons used as the working chamber. Some of the steel shafting which led up from these caissons was elliptical in section; we have a view of this in Fig. 7, and a section of wooden cofferdam is seen just to the left. In Fig. 5 we have in the foreground a view of the Moran air lock; an empty bucket is just being lowered into it and below, but connected to the lock, is to be seen the upper part of the steel shafting. Surrounding it may be observed some of the weights used to sink the pier against skin friction and the upward thrust of the air pressure. Upon this one contract a total of 1,200 tons of pig iron is said to have been employed in order to give sufficient weight to the caissons. It will be noticed that the shaft here is circular in cross-section. However, standing just to the right is a section of elliptical shaft. Back of these is to be seen a pier whose foot has probably not penetrated to the depth of the one in the foreground. The rectangular form is readily discernible. The lower portion of the part in sight is nothing but concrete with the cofferdam stripped off; above this portion a section of cofferdam is in view and above this an elliptical shaft is seen surmounted by the air lock. In Fig 7, on the right and close up to the wall may be seen a similar pier.

It is not always necessary to carry the caisson to bed rock, even though the excavation for the pier is carried that far. Thus, at the Singer building, the bed rock was overlaid by a stratum of hard pan and when the caisson had fairly entered this material, it could be stopped and the excavation completed without its use, but the concreting of the caisson and its shaft could, of course, not be done until the excavation was completed.

# THE LIFTING MAGNET AS AN INDUSTRIAL FACTOR

## An American Labor Saving Device Which is Rapidly Becoming Universal

An interesting comparison of conditions existing in American and European steel plants is afforded by noting the use made of electric lifting magnets here and abroad. Here in America the equipment of a modern steel making plant would be considered incomplete without one or more lifting magnets, while abroad their use is the exception rather than the rule. This condition is perhaps, partly due to the fact that the lifting magnet of European manufacture has not yet been brought to as high a standard of efficiency as the American magnet,

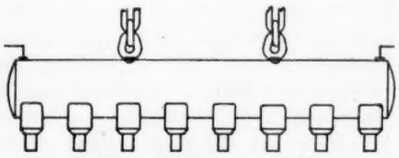


FIG. 1—THE "CATERPILLAR" MAGNET

but the real reason for the slower adoption of this labor-saving device in European countries is doubtless to be found in the lower cost of manual labor abroad. Certainly no charge of lack of progressiveness can be justly laid at the door of the European steel mills, for along other lines they have set us examples of industrial economy which we are only now beginning to follow. Throughout the foreign steel making districts labor is cheap and fuel expensive (measured by our standards) and the energies of the European manufacturer, therefore, have been naturally directed to reducing fuel costs, rather than to attempting to economize on the cost of labor. This is well illustrated by such a typical example as the Hildegarten Hütte in Austrian Silesia. Here was installed the first electrically operated reversing rolling mill, complete with an Ilgner fly wheel set (all in the interest of fuel economy), while in the same mill hand labor is still to be found everywhere employed, even in the manipulation of the steel on the tables.

In the United States, on the other hand, the question of fuel economy has attracted comparatively little attention, until recently, while the need of some labor-saving device that would reduce the cost of handling pig iron and scrap has long been apparent. In view of this fact it is somewhat remarkable that the lifting magnet has loomed large on the industrial horizon only within the past few years.

The explanation of this seeming neglect of what has proven to be a labor-saving device of real merit is to be found in the early attempts of inventors to solve the problem of handling material by means of magnets.

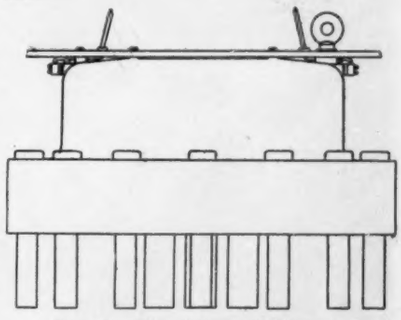


FIG. 2—THE "SPIDER" MAGNET

The possibility of constructing a device that would attract to itself iron or steel has long been known, but the first attempts to adapt the magnet of the laboratory to the handling of pig iron and scrap were foredoomed to failure. There is little similiarity between these early types of lifting magnets. In the

absence of experience each inventor tried out his own theories, usually to find that the form of construction that appeared excellent on paper failed to do what was expected of it when the magnet was subjected to the grueling test of actual service.

The fundamental laws of magnetism were well known to these early workers in the lifting magnet field, but opinions seem to have differed as to the proper interpretation of these laws. Thus we find some advocating the use of coils connected in series, while others favored connecting the coils in parallel. Similar differences of opinion existed concerning the proper shape of the magnet body. Rectangular magnets with flat faces had been found to be fairly efficient when used for handling plates, rails, or ingots, but when the attempt was made to use these same magnets for handling scrap or pig iron it was discovered that owing to the uneven surface presented by material of this nature the lift was greatly diminished.

Knowing that the attractive force a magnet exerts on the load to be lifted varies inversely with the square of the distance, *i. e.*, the attraction is greatest when the poles of the magnet are in close contact with the load and becomes rapidly less as the air gap between the two is increased, inventors sought to solve the problem of handling pig iron and scrap by constructing magnets with a multiplicity of movable poles, so that the inequalities of surface presented by a pile of irregularly shaped pieces of metal would be compensated for by the ability of the poles to adjust themselves to this condition. Thus were evolved what may be described as the "caterpiller" and "spider types of magnets, seen in Figs. 1 and 2, the former consisting of a long cylindrical shaped body with movable legs, or poles, and the latter a dome shaped body, also with downwardly projecting, movable poles, the whole roughly approximating a gigantic spider in form.

Theoretically the movable pole seemed to be a desirable feature; practically, however, magnets so constructed proved to be extremely inefficient, owing to the enormous magnetic leakage incident to their design. In spite of this such magnets found some purchasers, so urgent was the need of steel mills for any device that would reduce the labor cost of handling pig iron and scrap.

The form of magnet above described was soon succeeded by one more nearly resembling the magnet of the present day.

It is probably safe to say that the lifting magnet of the present day is likely to remain unchanged in its essential features for some years to come. Improvements in minor details will undoubtedly be made from time to time, but it is difficult to conceive of any radical changes in form or construction being made.

The development of the lifting magnet is historically as follows: About 14 years since, S. T. Wellman, then in charge of The Otis Steel Co., Cleveland, designed and put in service the first commercial lifting magnet, which was made for handling plates and slabs, and showed at once a saving of labor in this operation. The design was later improved by E. B. Clark, then electrical engineer for the South Works of the Illinois Steel Co. Many magnets of the Wellman and Clark designs were made and are operating today, giving entirely satisfactory service in handling smooth homogeneous material, such as plates, ingots, and slabs.

A magnet of this type, however, that will handle a 10,000 pound ingot, may not lift a long thin plate weighing 500 pounds, and would not lift a single pig weighing 100 pounds from an indiscriminate pile. It would appear that the design of a magnet for lifting smooth homogeneous magnetic material, such as plates, billets, and blooms, should require only calculations based on the elementary and well known laws of the magnetic circuit. It is true that the magnetic circuit of the magnet itself can be so calculated, but this circuit is not complete till the load is attached, and it is the completing of this circuit, as will be explained later, which causes the load to be lifted. The 10,000 pound ingot and the long thin 500 pound plate are loads of entirely different character. The ingot is of large cross section, and is rigid, whereas the plate has small cross section, is flexible, and will bend of its own weight. This bending introduces a lever action, tending to tear the plate from the magnet, and also a live load due to vibration; both of which strains are in addition to the dead weight of the plate. Thus, paradoxical as it may appear, it is more difficult to design a magnet for lifting light plates than for handling heavy ingots.

Both the ingot and plate may be covered with rust, scale, snow or ice, introducing an air gap of varying thickness, and this is an important factor, since it changes the total magnetic flux, and also its distribution.

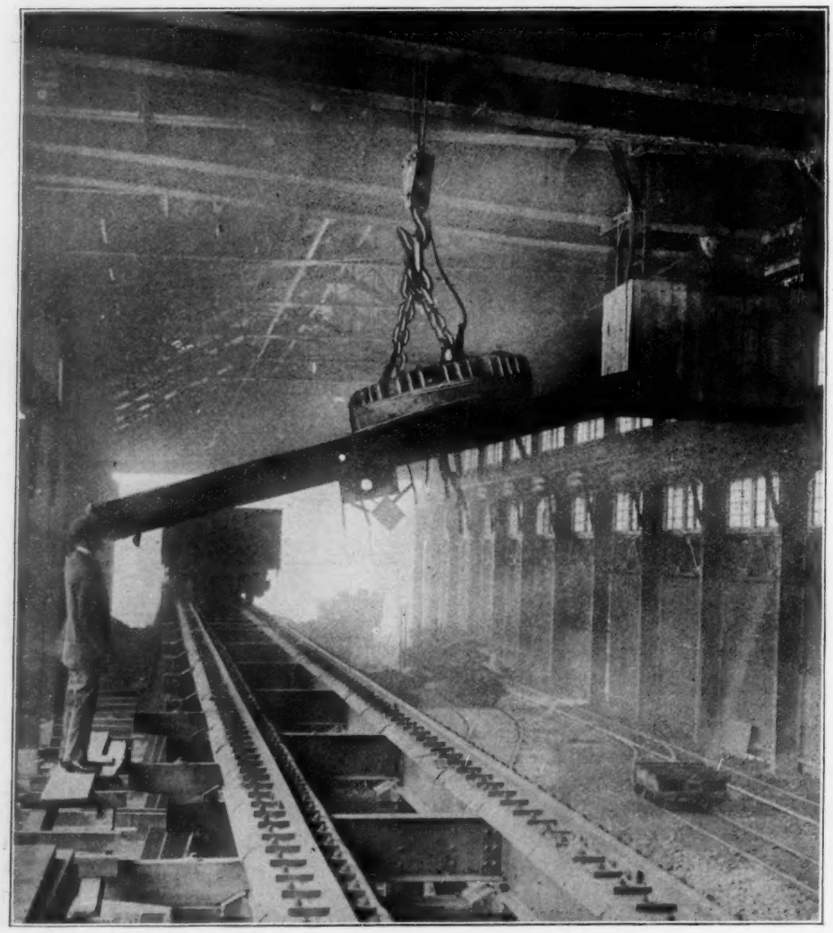


FIG. 3—THE EASTWOOD MAGNET (ELECTRIC CONTROLLER & MFG. CO.), LIFTING LONG BILLET. NOTE ADAPTABILITY TO ECCENTRIC WEIGHT

Both the ingot and plate present, however, a broad flat surface of contact with the magnet, whereas the pile of pig or scrap presents only points and lines of contact, while its coarse grained structure and free carbon content make a very poor magnetic circuit. These, and other causes, combine to require a different design of magnet.

The greatest tonnage of magnetic material to be handled occurs in miscellaneous form and usually in indiscriminate piles, such as scrap of all kinids, pig iron, etc. Before the introduction of modern unloading machinery it cost 20 cents per ton to unload iron ore by hand. Now, with the modern machinery, it costs about 2 cents per ton. The same opportunities for saving presented themselves in the handling of iron and steel, since with hand labor this was costing from 5 cents to 35 cents per ton, depending on local conditions.

### The Cost of Handling Reduced.

Attempts were therefore made to produce a successful lifting magnet for handling miscellaneous magnetic material, and the first promise of commercial results was obtained at the Lackawanna Steel Co.'s West Seneca plant. Under the direction of E. D. Edmondson a magnet was designed by S. Piek, that, although very heavy, and consuming much current, actually lifted six or eight pigs from an indiscriminate pile. This magnet was provided with seven center and 12 outer pole pieces, which could slide in pockets in the center and outer poles of the magnet, and thus adjust themselves to an uneven surface, such as a pile of pig or scrap. This idea seemed good, but the magnet was too heavy and took too much current to be commercially successful. Many other attempts were made to produce a magnet that would lift pig from an indiscriminate pile, but no success was met with till about five years ago.

The Eastwood design, made by the Electric Controller & Mfg. Co., Cleveland, dates from 1904 and produced a lifting magnet weighing about 5,000 pounds, which lifted an average of about 1,500 pounds of pig iron and got occasional lifts of 2,000 pounds. Since then this design of magnet has been refined and improved, so that a magnet weighing only about 3,000 pounds will lift almost as much, and the structural features have been so improved that the lifting magnet today is a very dependable tool, with low upkeep and operating costs.

The Cutler-Hammer Clutch Co., Milwaukee, also brought out a design about this time on very similar lines and many hundreds of this same general design of lifting magnet have been furnished by various manufacturers, and savings equivalent to those in ore handling have been effected. It can now be said that bulk magnetic material, such as pig iron, all kinds of scrap, small castings, etc., can be handled by lifting magnets at an average of 2 cents per ton. In fact the average is probably less than this, because although some few plants using magnets report a higher cost, the large majority are operating at a less cost; many below 1 cent per ton for labor and power, and below 2 cents per ton, adding all the interest and depreciation of crane, crane runway and magnet.

This general design of lifting magnet is practically universal in its application. Beside pig iron and all kinds of scrap, lifting magnets are being used to handle large forging billets up to 30,000 pounds, large castings, bar iron, structural material, rails, long billets, cast iron pipe, paper filled car wheels, upright steam boilers, nails, spikes, bolts, etc., in kegs or boxes, charging boxes and charging box buggies. They are also being used to shift charging box buggies and steel railroad cars under crane runways when switch engine is not available.

Lifting magnets are now being successfully used to handle hot bar iron from cooling beds, car wheels from annealing pits, hot crop ends and hot billets. Their capacity in this class of work is, however, less than when handling cold material, due to the fact that the current is reduced as the temperature of the magnet rises, because the resistance of the coil increases with increase of temperature. When handling hot material, the magnet should be sprayed with water to keep down its temperature. The difference in capacity when handling hot and cold material is indicated by the following test: A large magnet handling 4 x 4 x 36-inch billets from an indiscriminate pile. Average of 700 lifts of cold billets was 2,976 pounds per lift. Average of 700 lifts of billets, black hot in daylight, slight color

FIG. 4—CUTLER-HAMMER MAGNET HANDLING CAR COUPLERS, ETC. NOTE ECCENTRIC WEIGHTS.

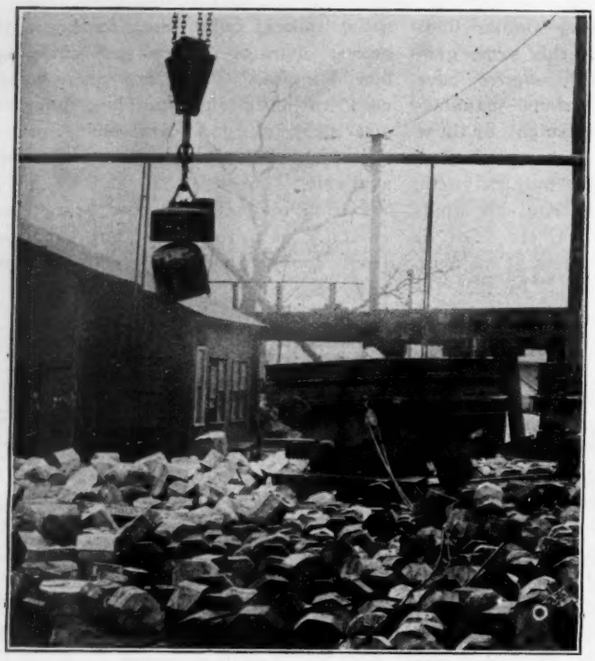


FIG. 5—EASTWOOD MAGNET LIFTING INGOT CROP ENDS. NOTE THE POINT CONTACT.

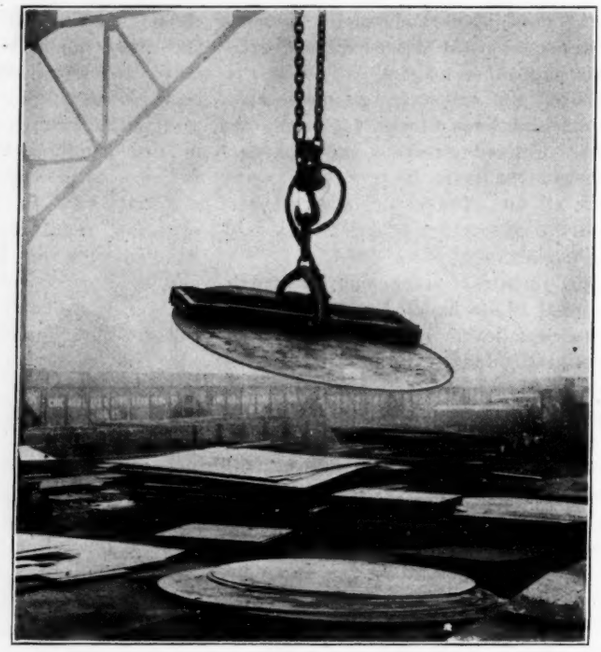


FIG. 7—EASTWOOD MAGNET LIFTING PLATES; AN EXAMPLE OF FLAT SURFACE CONTACT.

shown at night, 2,500 pounds per lift.

A curious fact in regard to the magnetic properties of iron and steel is that just as the color is turning from very dull to bright red, the magnetic properties practically disappear. It is therefore impossible to handle iron and steel at a bright red heat with the lifting magnet.

Although magnets will lift very large weights of homogeneous magnetic material, such as 30,000 pound forging billets, and 25,000 pound skull cracker balls, the largest magnets on the market today will average not much over 3,000 pounds in handling miscellaneous magnetic material such as billets, crop ends, steel risers, etc. However, their daily capacity is very large because no time is lost in attaching or detaching the load. Since the individual lift is relatively small, magnets should be operated from fast cranes so that many lifts per hour may be made. Many magnets are now operating which will unload a 100,000 pound car load of pig iron in from 20 to 30 minutes. A run with one magnet and crane is reported where 26,000 tons of scrap were handled in 20 days. These instances might be multiplied indefinitely and a conservative estimate of laborers replaced is seven per turn per magnet.

It might be interesting to the non-electrical reader to know just why a

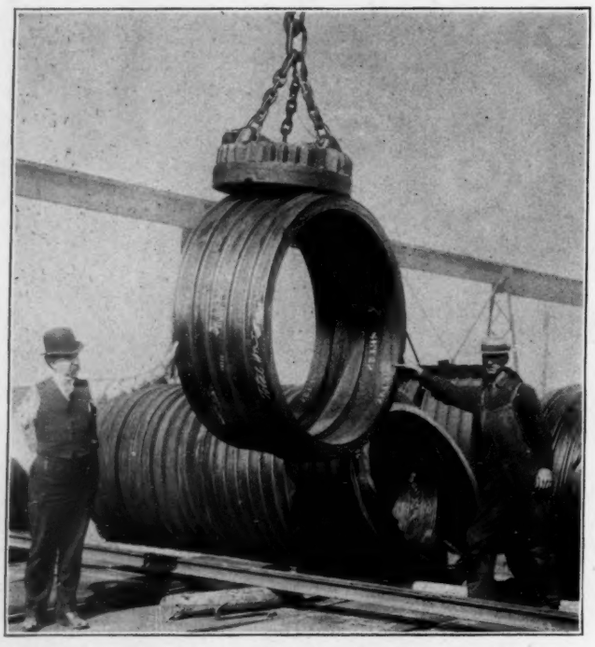


FIG. 6—EASTWOOD MAGNET LIFTING LOCOMOTIVE TIRES; AN EXAMPLE OF POINT CONTACTS.

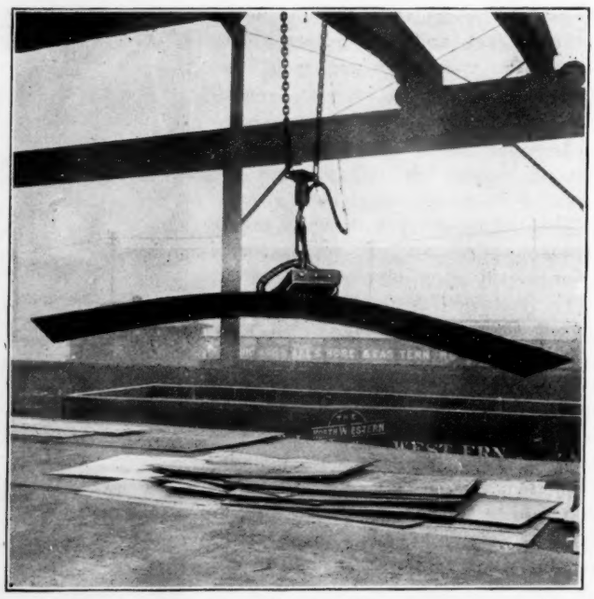


FIG. 8—AN EASTWOOD MAGNET HANDLING PLATE. AN EXAMPLE OF LINE CONTACT AND OF THE DIFFICULT PROBLEM INVOLVED IN HANDLING FLEXIBLE MATERIAL.

magnet lifts its load. Everyone is familiar with the little horseshoe magnet. This is of hard steel which has been magnetized by being brought under the influence of a strong electro magnet. Hard steel will retain its magnetism indefinitely. When the horseshoe shaped piece of hard steel is brought under the influence of the strong electro magnet it is filled with what are termed "lines of force," which it retains, and becomes a horseshoe magnet. When this magnet is not near any iron the lines of force will distribute themselves through the air about as shown in Fig 10.

If now this magnet is brought near a small wire nail, these lines of force will begin to thread themselves through the nail, as shown in Fig. 11.

**The Operation of the Magnet.**

In this position the lines of force may be likened to rubber bands threaded through the nail and pulling on it, but unable to lift it. If the magnet is actually touched to the nail, as shown in Fig. 11, all the lines of force will thread themselves through the nail, and it will be lifted.

In Figs. 10 and 11 the magnetic circuit is incomplete, and in Fig. 12 it is completed by the load to be lifted.

Anyone can get a horseshoe magnet at any hardware store, and try an experiment with the aid of a mailing scale. If the small piece of steel that comes with the magnet, or a wire nail, is placed on the scale it will be seen that the weight is reduced as the magnet approaches the piece of steel or nail. The weight is reduced because more and more lines of force thread themselves through the nail as the magnet approaches it, and they are like rubber bands threaded through the nail, tending to lift it. If the nail is small and the magnet strong, the nail will jump to the magnet through more or less air space. If a soft piece of steel instead of a hard piece is used and a coil of wire is wound around the steel, as in Fig. 13, and an electric current is sent through the coil, the steel will be magnetized and we will have an electro magnet.

Soft steel will not retain its magnetism, so when the current is cut off the electro magnet will drop its load. Thus magnetic material may be picked up and dropped by simply closing and opening the switch supplying current to its coil.

Two horseshoe magnets may be combined, as shown in Fig. 14, using only one coil. In this form there are two streams of lines of force, as shown.

Now suppose an infinite number of these magnets are assembled in a circular form, and then fused together, —an annular body or frame would be formed with the coil surrounding the center pole, as in Fig. 15, which is a diagramatic cross section of a modern lifting magnet.

The different manufacturers vary widely in the details of construction, but a magnet to stand continuous hard work should fulfill the following general specifications:

The steel case should be amply strong to withstand the shocks received by swinging against ingots and other heavy pieces.

It should be of special electrical steel carefully annealed, so as to drop its load instantly.

The suspension should be stable and capable of standing a strain of 25,000 pounds with liberal safety factor.

The wires carrying current to the coil should be protected from mechanical injury, and this protection should be strong enough not to break if swung against an ingot or caught under a railway car.

The magnet should be provided with renewable pole shoes, so arranged that they can be easily renewed on the job.

The magnet should be provided with a bottom or wearing plate of manganese steel.

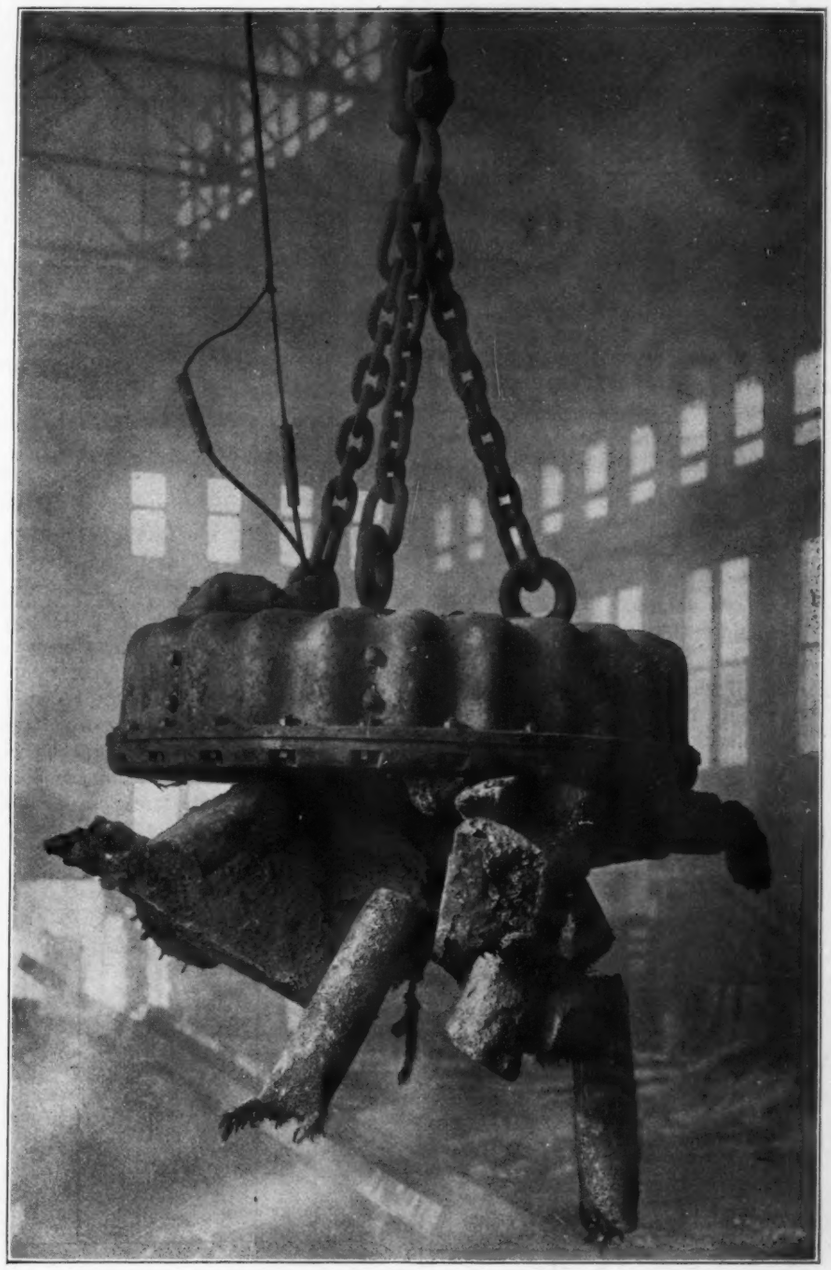


FIG. 9—A CUTLER-HAMMER MAGNET HANDLING SAND-CAST PIG IRON.

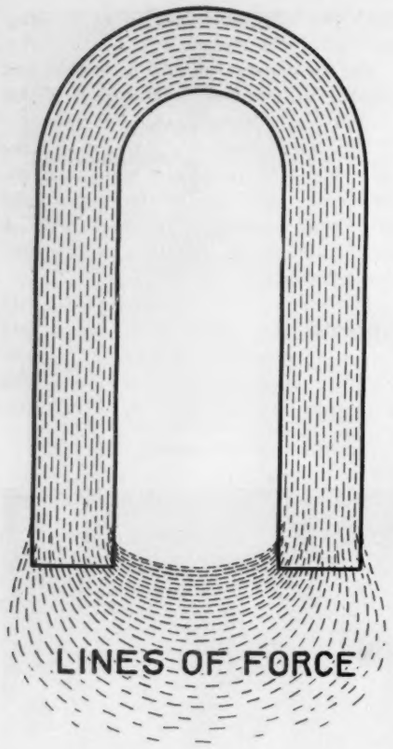



FIG. 10

The magnet case should be made absolutely water tight, so that no moisture can reach the coil.

No inflammable material whatever should be used in the magnet, particularly in any part of the coil.

The coil should be held rigidly in the magnet case so that it can not move in any direction.

The coil should be protected from the hammer blow delivered in dropping on its load.

One of the important latter-day improvements is the impregnation of the magnet with a water-proof, insulating compound, injected under pressure after the air has been completely exhausted by a vacuum process. This serves as a seal against moisture finding its way into the interior of the magnet, either in the form of water or in the more insidious form of moisture-laden air, which when the magnet became heated in service was converted into steam and formerly gave rise to innumerable troubles. As now constructed, breakdowns need hardly be feared on account of moisture short circuiting the coil since the methods of water proofing are so efficient that it is not unusual nowadays to see a magnet being cooled off by playing a hose on it.

In respect of dimensions of magnets manufacturers are practically in accord as to the most suitable size for each particular purpose. While the sizes vary an inch or two one way or they all closely approximate the following diameters: 60 inches, 51 inches, 42 inches, 36 inches, 12 inches.

The 60-inch, 51-inch and 42-inch magnets are the ones generally preferred for handling pig iron and scrap. The first of these has only recently come into use and seems to have been developed to meet the requirements of the larger plants, whose output is sufficiently great to enable them to keep one or more magnets constantly employed in handling billets, pig iron and scrap. The 50-inch magnet is used for the same purpose and in the majority of mills is preferred to the 60-inch magnet because of its lighter weight and lower cost. The 42-inch magnet may be described as a general utility tool and, all things considered, is perhaps the most useful for the plant of average size. The cost and weight of this size are only about half that of a 51-inch magnet, while its lifting capacity is only about 500 pounds less than the larger magnet. It is the size generally pre-

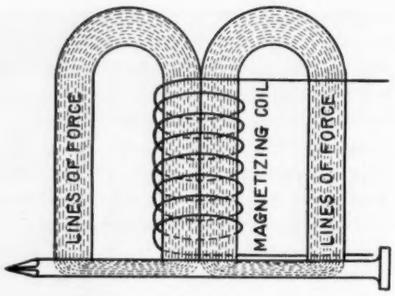



FIG. 14

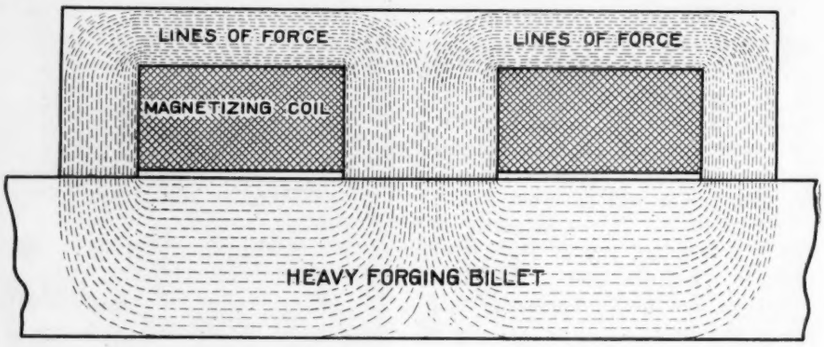



FIG. 15

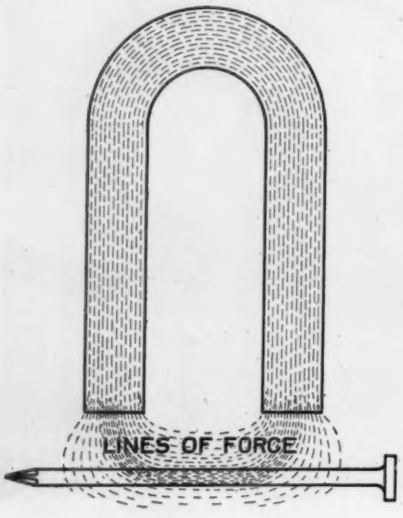



FIG. 11

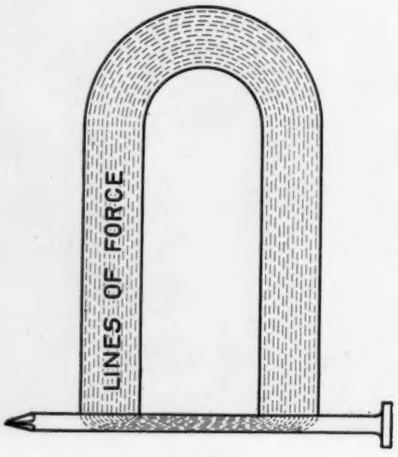



FIG. 12

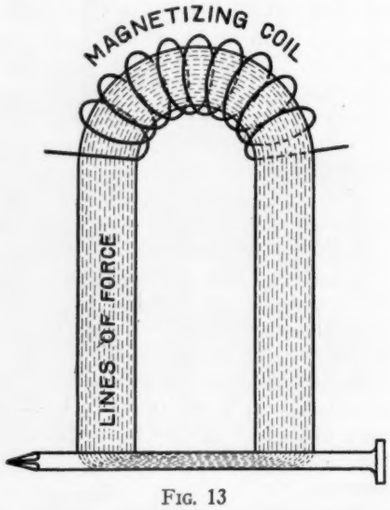



FIG. 13

ferred for use with locomotive cranes, but may of course be used with overhead traveling cranes as well. In the first case it is usually supplied with a yoke and single link suspension requiring only about 2 feet headroom, while for use with overhead traveling cranes or gantries the familiar tripod chain form of suspension, commonly used with magnets of larger size, is employed.

The 36-inch magnet is likewise often used with locomotive cranes, and finds also a wide field of usefulness in skull-cracker work.

The 12-inch magnet weighs only about 75 pounds, but is capable of lifting a casting weighing a ton or more. It is principally employed for handling tank heads, boiler plate and castings, not being suitable for use with broken material.

Quite recently a hand magnet has been placed on the market. This is energized from an ordinary incandescent lamp socket and is provided with a push button in the handle for opening and closing the circuits to the coils. It finds its principal fields of usefulness in machine shops, hardware stores and foundries. It is also used in the packing rooms of large establishments for the purpose of reclaiming nails from the sweepings.

The circular, or "mushroom" form for handling pig iron or scrap has been adopted by all manufacturers of lifting magnets, this form of magnet body being dictated by the form of the coil which it encloses. The coil itself is now always constructed of strap copper with mica and asbestos insulation. Manganese steel is today generally used for the coil shields of magnets being infinitely more durable than the brass formerly employed for this purpose. The eye-bolts, which at first were used for securing the chains by which the magnet was suspended from the crane hook, proved to be a source of annoyance, due to frequent breakage, and have now been generally abandoned in favor of heavy lugs cast integral with the magnet body, as shown in the various illustrations.

In addition to the standard types described above a great variety of lifting magnets for special purposes are manufactured. Magnets for handling plates, rails, pipe, sheet metal, etc., are nearly always rectangular in form and are often provided with special pole pieces so designed as to bring the particular shape to be handled in intimate contact with the magnet poles.

All lifting magnets of whatever make are designed for use on direct current circuits only, and usually for 115 or 230 volts. This is because the

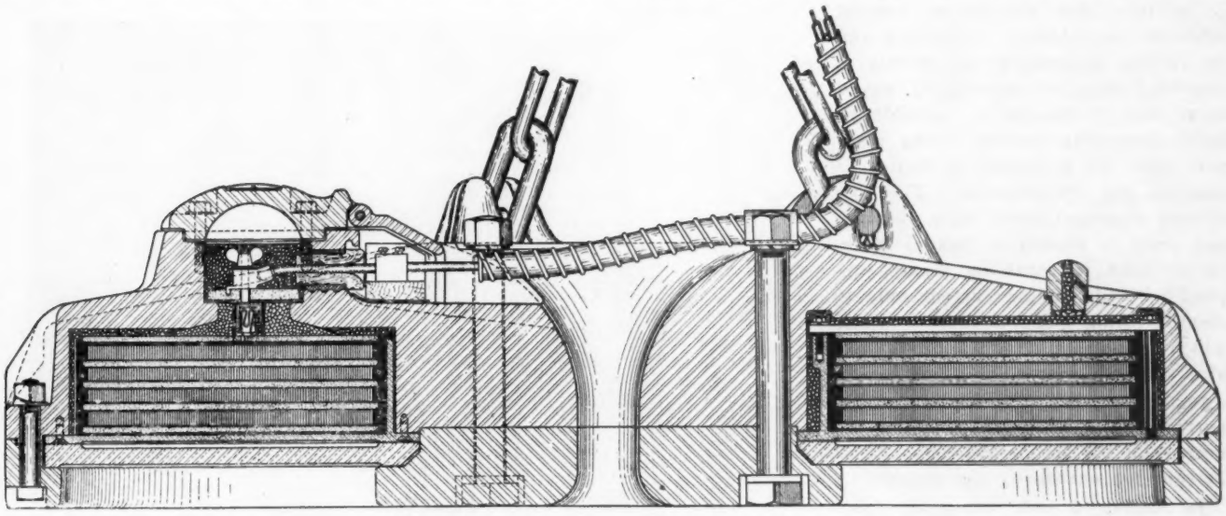


FIG. 16—CROSS SECTION OF THE ELECTRIC CONTROLLER & MFG. CO.'S LIFTING MAGNET.

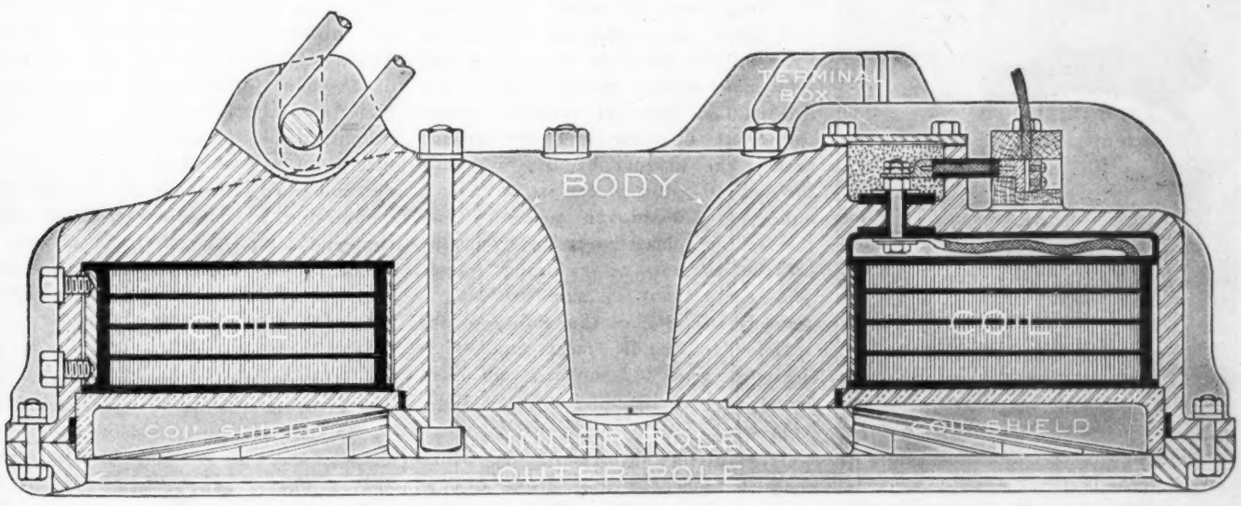



FIG. 17—CROSS SECTION OF A CUTLER-HAMMER CLUTCH CO.'S LIFTING MAGNET.

characteristic reversal of current in an alternating current source of supply makes it unsuitable for the continuous energizing of the magnet coil. It is true that alternating current solenoids are common nowadays and the lifting magnet being merely a magnified form of solenoid it would seem that it should be possible to build alternating current lifting magnets also. As a matter of fact it is possible, but not practical. The cost of such a magnet would be prohibitive and there is already a cheaper method at hand for enabling plants supplied with alternating current only to employ lifting magnets in their work, which consists in using a motor-generator set, the motor of which is designed for operation on an alternating current circuit while the generator operated by the motor generates direct current for energizing the magnet.

In closing, a very important application of lifting magnets should be mentioned. That is, the magnetic handling of skull cracker balls. The old method of a latch engaging a link fastened to a pear-shaped ball was slow, inefficient, and dangerous to life. The ball usually settled with the link underneath, so much time and labor was expended in turning it so as to expose the link. The latch was tripped by pulling on a rope, and often this pulling started the ball to swinging, and destroyed the aim, resulting in a miss when the ball was released. The man pulling the latch was always in a dangerous position, liable to be hit by flying pieces of metal. Much time and labor was expended in moving by hand the pieces to be broken, and then the broken pieces. With the magnet, no labor is required except the crane operator and one ground man. The magnet handles not only the ball, but the pieces to be broken and then the broken pieces. Since the ball is released by simply cutting off the current, no swinging occurs, and every shot is sure to hit. A striking example of the ability of the magnet to handle large masses is seen in Fig. 18, showing an Eastwood magnet handling a large skull-cracker.

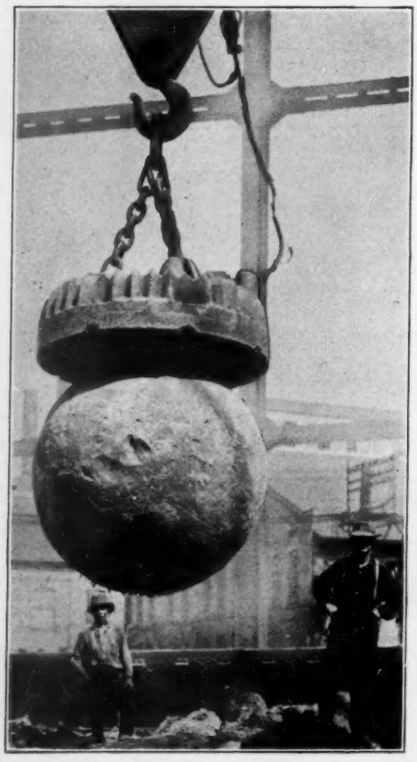


FIG. 18—EASTWOOD MAGNET HANDLING SKULL CRACKER, POINT CONTACT.

Tracing the history of the lifting magnet from the first crude designs of 10 or 12 years ago to the wonderfully efficient magnets of the present day, one is impressed by the fact that more radical improvements in lifting magnets have been made in the past three or four years than in all the preceding years during which inventors were groping for a solution of the problem that confronted them. These problems involved the making of a magnet that should be at once high in lifting capacity, light in weight, absolutely fire-proof and moisture-proof and which, moreover, would be able to withstand the continued hammering of countless tons of pig iron and scrap—and all to be accomplished without making the costs of the magnet prohibitive to even the smallest mill.

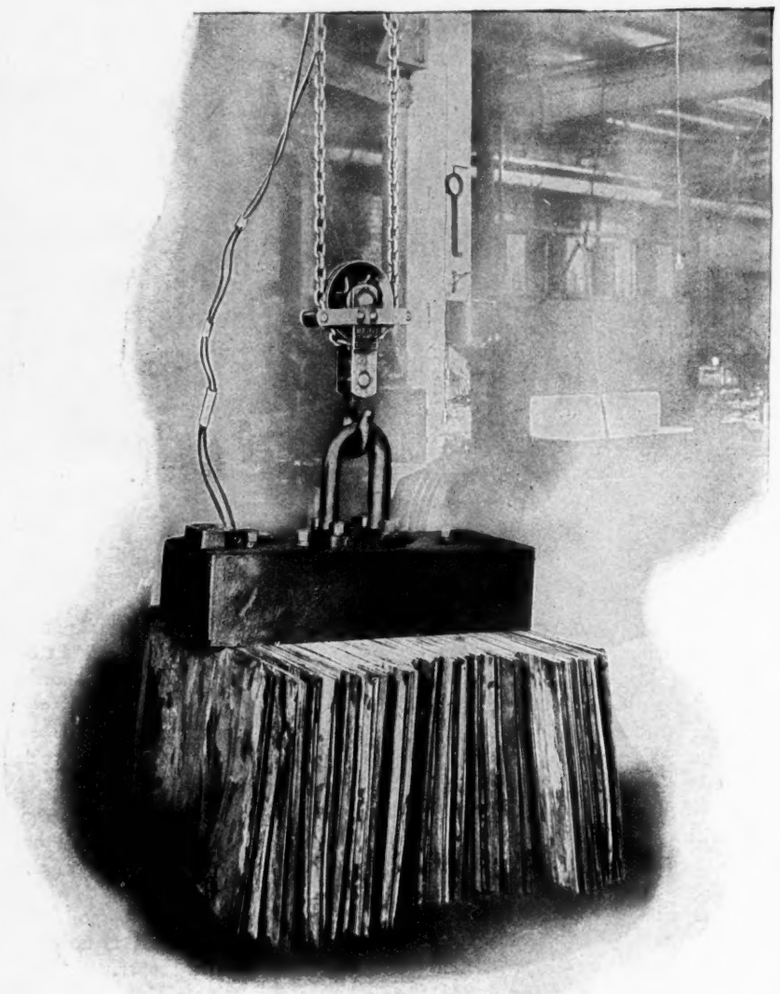
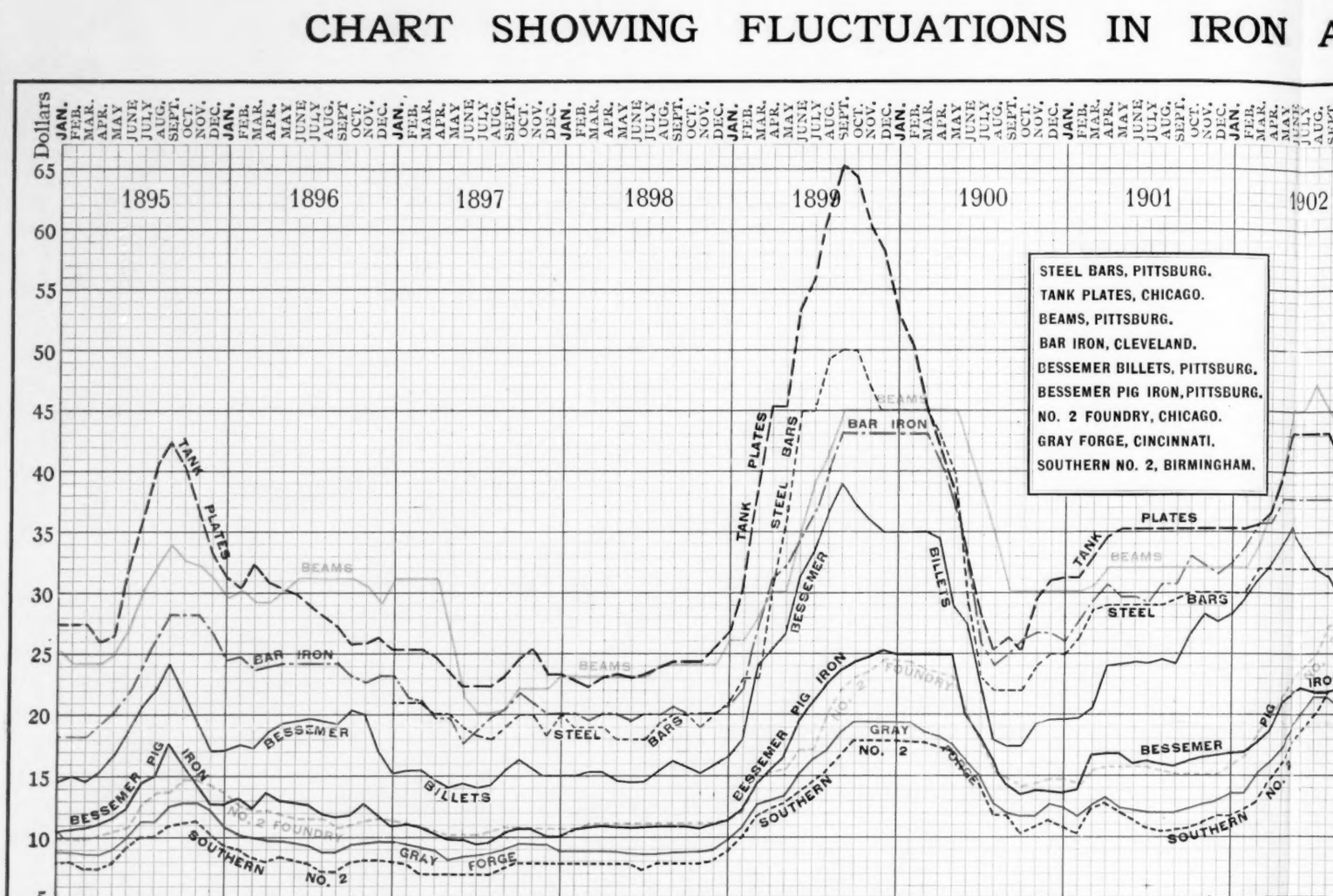


FIG. 19—CUTLER HAMMER MAGNET HANDLING SHEETS

How well these have been worked out is demonstrated by the widespread and growing use of the lifting magnet as an essential ite mof equipment of present day plants and by the fact that a magnet can be had today at a price of about half that of a few years since.

# THE IRON TRA

## CHART SHOWING FLUCTUATIONS IN IRON A




## AVERAGE MONTHLY PRICES OF IRON AN

(FINISHED PRODUCTS IN NET TONS. PIG IRON AN

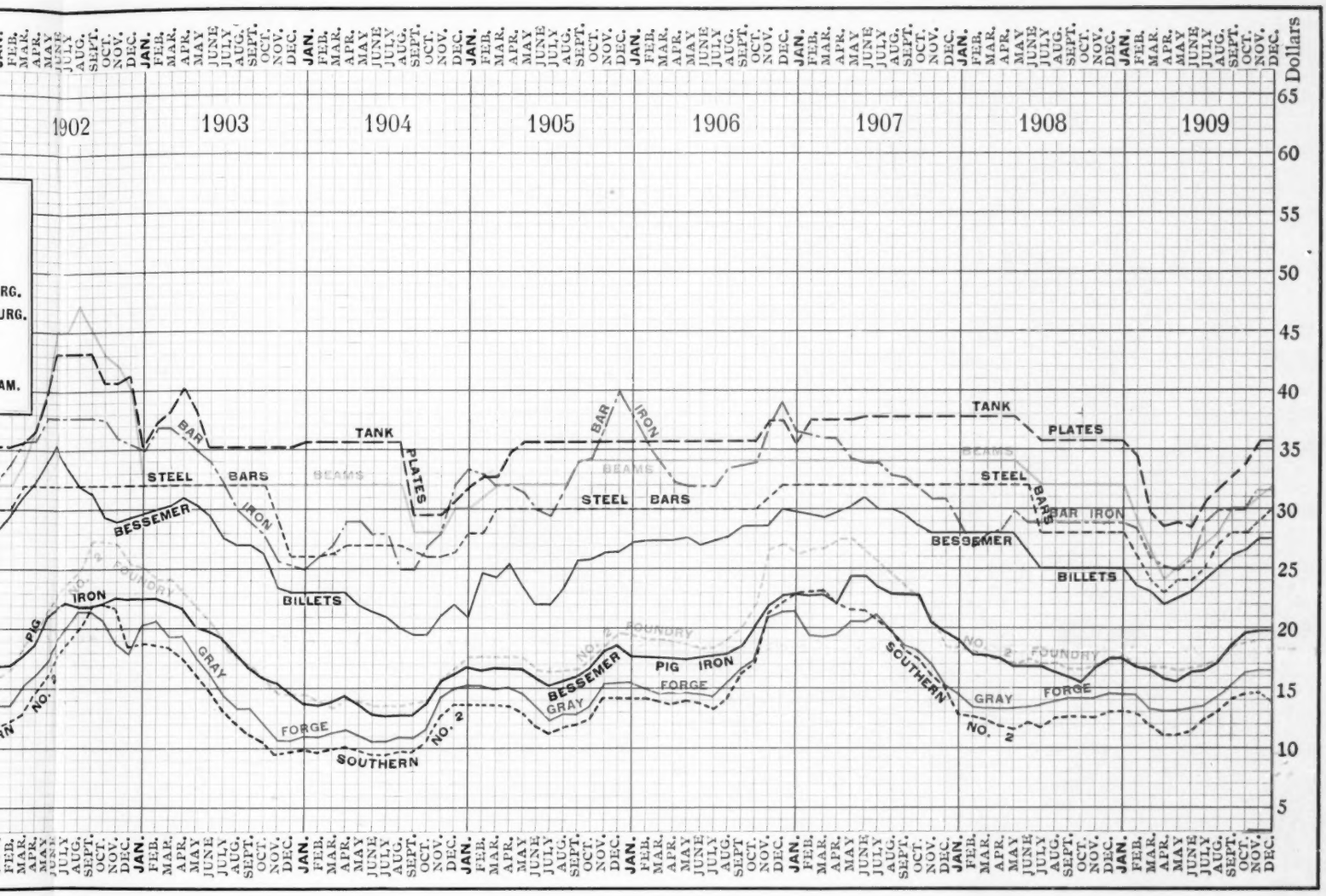
| | 1900 | | | | | | | | | | | | 1901 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| No. 2 Foundry Chicago .. | $24.50 | 24.25 | 23.75 | 23.25 | 22.00 | 20.25 | 17.75 | 15.50 | 14.50 | 14.00 | 14.25 | 14 60 | $14.60 | 14.12 | 15.19 | 15.50 | 15.50 | 15.50 | 15.50 | 15.20 | 15.00 | 15.00 | 15.00 | 15.50 |
| Gray Forge Cincinnati... | $19.25 | 19.25 | 18.75 | 18.40 | 17.75 | 16.25 | 15.25 | 12.90 | 12.00 | 11.75 | 11.75 | 12.75 | $12.25 | 11.87 | 12.56 | 13.12 | 12.60 | 12.25 | 12.00 | 12.00 | 12.00 | 12.25 | 12.69 | 13.00 |
| Plates Chicago..... | $52.50 | 50.00 | 45.25 | 42.00 | 38.75 | 32.75 | 28.00 | 25.00 | 26.00 | 25.00 | 29.25 | 30.75 | $31.00 | 30.00 | 32.40 | 34.40 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 |
| Billets (Bess.) Pittsburg.. | $35.00 | 35.00 | 35.00 | 34.50 | 29.00 | 27.25 | 22.50 | 18.00 | 17.50 | 17.50 | 19.30 | 19.75 | $19.75 | 19.75 | 20.81 | 24.12 | 24.20 | 24.44 | 24.25 | 24.40 | 24.12 | 26.80 | 28.25 | 27.62 |
| Bessemer Pig Pittsburg.. | $24.90 | 24.90 | 24.90 | 24.90 | 24.90 | 19.75 | 18.00 | 16.05 | 14.00 | 13.25 | 13.65 | 13.55 | $13.25 | 13.60 | 16.56 | 16.69 | 16.65 | 15.94 | 16.00 | 15.90 | 15.71 | 15.90 | 16.10 | 16.35 |
| Beams Pittsburg..... | $45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 41.50 | 38.00 | 34.80 | 30.00 | 30.00 | 30.00 | 30.00 | $30.00 | 30.00 | 30.40 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 |
| Bar Iron Cleveland..... | $43.00 | 43.00 | 43.00 | 40.50 | 37.25 | 33.00 | 26.00 | 24.00 | 25.00 | 26.00 | 26.75 | 26.75 | $25.80 | 27.80 | 29.30 | 30.80 | 29.80 | 29.80 | 29.40 | 30.80 | 30.60 | 32.80 | 32.00 | 31.70 |
| No. 2 Fd'ry, Birmingham. | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

| | 1905 | | | | | | | | | | | | 1906 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
| No 2 Foundry Chicago... | $17.50 | 17.50 | 17.50 | 17.50 | 17.25 | 16.60 | 16.15 | 16.35 | 16.50 | 17.55 | 18.90 | 19.50 | $19.25 | 19.25 | 19.00 | 18.75 | 18.50 | 18.10 | 18.30 | 18.90 | 19.75 | 21.50 | 26.50 | 27.00 |
| Gray Forge Cincinnati... | $15.25 | 15.20 | 15.00 | 15.20 | 14.81 | 13.35 | 12.28 | 13.00 | 13.00 | 13.88 | 15.35 | 15.75 | $15.75 | 15.05 | 14.85 | 14.75 | 14.75 | 14.65 | 14.55 | 15.40 | 16.50 | 17.50 | 21.70 | 22.00 |
| Plates Chicago..... | $31.30 | 32.30 | 32.30 | 34.80 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | $35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 37.30 |
| Billets (Bess.) Pittsburg.. | $21.00 | 24.90 | 24.60 | 25.50 | 23.50 | 22.00 | 22.00 | 23.50 | 25.75 | 25.95 | 26.30 | 26.50 | $27.00 | 27.50 | 27.65 | 27.75 | 27.00 | 26.25 | 27.00 | 28.00 | 28.50 | 28.50 | 29.00 | 29.75 |
| Bessemer Pig Pittsburg.. | $16.85 | 16.45 | 16.35 | 16.30 | 16.20 | 15.65 | 15.00 | 15.40 | 15.90 | 16.50 | 17.70 | 18.10 | $17.32 | 17.29 | 17.26 | 17.25 | 17.24 | 17.38 | 17.57 | 17.96 | 18.44 | 20.06 | 21.96 | 22.75 |
| Beams Pittsburg..... | $30.00 | 31.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 34.00 | 34.00 | 34.00 | 34.00 | $34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 |
| Bar Iron Cleveland..... | $33.25 | 33.00 | 32.00 | 32.00 | 31.50 | 30.00 | 29.75 | 32.00 | 34.00 | 34.25 | 37.20 | 40.00 | $38.00 | 35.50 | 34.00 | 33.00 | 32.00 | 32.00 | 32.00 | 33.50 | 34.00 | 36.00 | 39.00 | 39.00 |
| No. 2 Fd'ry Birmingham. | $13.50 | 13 50 | 13.50 | 13.25 | 12.75 | 11.85 | 11.00 | 11.65 | 11.75 | 12.50 | 14.00 | 41.00 | $14.00 | 14 00 | 13.70 | 13 65 | 13.75 | 13.50 | 13.00 | 14.15 | 16.00 | 17.15 | 21.25 | 22.00 |


SUPPLEMENT TO
THE IRON TRADE REVIEW
JAN. 6, 1910

# TRADE REVIEW

## ON AND STEEL PRICES FOR FIFTEEN YEARS.




## IRON AND STEEL PRODUCTS, 1900-1909.

ONS. PIG IRON AND BILLETS IN GROSS TONS.)

1902

| | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 8.62 | 19.75 | 21.75 | 22.50 | 23.40 | 24.66 | 27.15 | 27.15 | 26.90 | 25.40 |
| | 5.25 | 16.00 | 17.05 | 18.93 | 20.00 | 21.50 | 21.50 | 20.60 | 18.87 | 18.00 |
| | 5.25 | 36.25 | 38.60 | 43.00 | 43.00 | 43.00 | 43.00 | 40.60 | 40.50 | 41.00 |
| | 1.37 | 32.25 | 33.90 | 35.18 | 33.50 | 32.12 | 31.50 | 29.80 | 29.00 | 29.25 |
| | 7.56 | 18.25 | 20.95 | 21.25 | 22.00 | 21.75 | 21.75 | 21.95 | 22.25 | 22.12 |
| | 4.00 | 37.00 | 40.00 | 45.00 | 45.00 | 47.00 | 45.00 | 43.00 | 42.00 | 40.00 |
| | 5.70 | 35.75 | 37.70 | 37.70 | 37.70 | 37.70 | 37.70 | 37.50 | 36.20 | 35.70 |
| | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |

1903

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $25.00 | 24.00 | 24.00 | 23.00 | 21.70 | 20.50 | 18.50 | 17.50 | 16.85 | 15.90 | 14.50 | 14.30 |
| | $20.50 | 20.75 | 19.35 | 19.20 | 17.70 | 16.50 | 14.60 | 13.50 | 13.25 | 12.30 | 10.95 | 10.75 |
| | $35.00 | 37.00 | 38.00 | 40.00 | 37.75 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 |
| | $29.75 | 30.00 | 30.25 | 31.00 | 30.50 | 29.50 | 27.50 | 27.00 | 27.00 | 26.50 | 23.50 | 23.00 |
| | $22.35 | 22.35 | 22.00 | 21.60 | 20.00 | 19.85 | 19.00 | 17.85 | 16.35 | 15.85 | 15.25 | 14.35 |
| | $35.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 |
| | $32.00 | 37.00 | 37.00 | 36.00 | 35.00 | 33.75 | 22.00 | 30.00 | 29.00 | 28.00 | 26.00 | 25.50 |
| | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... |

1904

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $14.10 | 13.75 | 13.55 | 14.00 | 13.80 | 13.40 | 13.30 | 13.35 | 13.40 | 13.70 | 15.60 | 16.60 |
| | $11.00 | 11.00 | 11.25 | 11.75 | 11.25 | 10.75 | 10.75 | 11.00 | 11.00 | 11.75 | 14.25 | 15.00 |
| | $35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 35.30 | 29.30 | 29.30 | 30.10 |
| | $23.00 | 23.00 | 23.00 | 23.00 | 22.00 | 21.50 | 21.00 | 20.00 | 19.50 | 19.50 | 21.00 | 21.00 |
| | $13.60 | 13.35 | 13.85 | 14.10 | 13.60 | 12.60 | 12.50 | 12.65 | 12.75 | 13.35 | 15.25 | 16.60 |
| | $32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 28.00 | 28.00 | 28.00 | 30.00 |
| | $25.00 | 26.00 | 27.00 | 29.00 | 29.00 | 28.00 | 28.00 | 25.00 | 25.00 | 27.00 | 28.00 | 32.00 |
| | $ 9.75 | 9.50 | 9.70 | 10.00 | 9.65 | 9.15 | 9.15 | 9.50 | 9.50 | 10.65 | 12.75 | 13.05 |

1907

| | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 6.75 | 27.00 | 27.40 | 26.50 | 25.40 | 24.50 | 23.60 | 22.60 | 20.60 | 19.00 |
| | 2.70 | 21.25 | 21.90 | 21.35 | 20.55 | 19.95 | 18.85 | 18.45 | 17.35 | 15.50 |
| | 7.30 | 37.00 | 39.40 | 39.60 | 39.60 | 39.60 | 36.60 | 37.60 | 37.60 | 37.60 |
| | 9.25 | 29.75 | 30.25 | 31.00 | 30.00 | 30.00 | 29.50 | 28.50 | 28.00 | 28.00 |
| | 2.85 | 22.85 | 24.10 | 24.40 | 23.30 | 22.90 | 22.90 | 22.80 | 20.60 | 19.90 |
| | 4.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 34.05 | 34.00 |
| | 6.00 | 36.00 | 35.00 | 34.00 | 34.00 | 33.00 | 33.00 | 32.50 | 31.00 | 31.00 |
| | 2.75 | 22.00 | 21.40 | 21.25 | 20.50 | 19.80 | 18.12 | 17.65 | 16.00 | 14.91 |

1908

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $18.24 | 17.87 | 17.42 | 17.21 | 17.00 | 17.31 | 17.00 | 17.00 | 16.75 | 16.50 | 16.75 | 17.35 |
| | $14.45 | 14.06 | 13.63 | 13.60 | 13.50 | 13.75 | 13.70 | 14.00 | 14.25 | 14.25 | 14 25 | 14 75 |
| | $37.60 | 37.60 | 37.60 | 37.60 | 37.60 | 36.60 | 35.60 | 35.60 | 35.60 | 35.60 | 35 60 | 35.60 |
| | $28.00 | 28.00 | 28.00 | 28.00 | 28.00 | 26.50 | 25.00 | 25.00 | 25.00 | 25 00 | 25.00 | 25.00 |
| | $19.00 | 17.90 | 17.86 | 17.49 | 16.92 | 16.90 | 16.73 | 16.11 | 15.90 | 15.48 | 16-74 | 17.40 |
| | $34.00 | 34.00 | 34.00 | 34.00 | 34.00 | 33 00 | 32.00 | 32 00 | 32.00 | 32.00 | 32.00 | 32.00 |
| | $28.80 | 27.00 | 28.00 | 28.40 | 30.00 | 29.00 | 29.00 | 29.00 | 29.00 | 29 00 | 29.00 | 29.00 |
| | $12.80 | 12.50 | 12.12 | 11.90 | 11.50 | 12.00 | 11.60 | 12.06 | 12.50 | 12.50 | 12 50 | 13.00 |

1909

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $17.44 | 16.75 | 16.50 | 16.46 | 16.21 | 16.41 | 16.90 | 17.37 | 18.20 | 18,87 | 19.00 | 19.00 |
| | $14.75 | 14.62 | 13.50 | 13.25 | 13.31 | 13.50 | 13.95 | 14 62 | 15-25 | 16.62 | 16.75 | 16.75 |
| | $35.60 | 34.10 | 29.60 | 28.60 | 28.95 | 28.30 | 30.60 | 31.60 | 32 80 | 33.60 | 35.60 | 35.60 |
| | $25.00 | 23.50 | 23.00 | 22.00 | 22.50 | 23.00 | 24.00 | 25.00 | 26.00 | 26.50 | 27.50 | 27.50 |
| | $17.34 | 16.78 | 16.34 | 15.80 | 15 48 | 16.13 | 16.37 | 17.13 | 18.33 | 19.68 | 19.90 | 19.90 |
| | $32.00 | 29.00 | 26.00 | 24.00 | 25.00 | 26 00 | 27.00 | 28 00 | 30.00 | 30.00 | 31.00 | 32 00 |
| | $29.00 | 28.75 | 26.20 | 25.25 | 25-00 | 26.20 | 29.25 | 30 00 | 30 00 | 30.00 | 32.00 | 32.00 |
| | $13.00 | 12.70 | 11.75 | 11.00 | 11-00 | 11.31 | 12.30 | 13.00 | 14 00 | 14.50 | 14.50 | 14.00 |